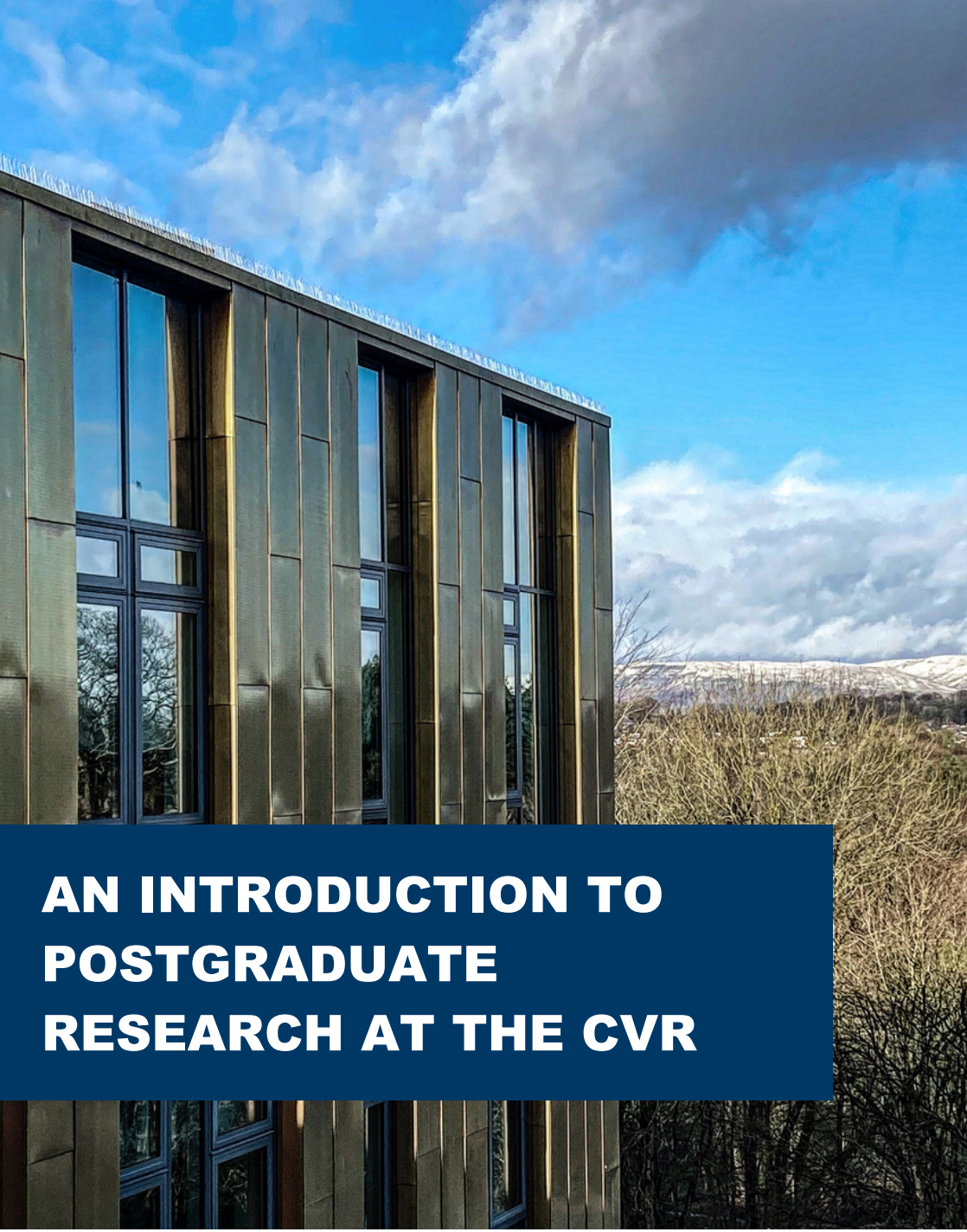

# AN INTRODUCTION TO POSTGRADUATE RESEARCH AT THE CVR

UKRI Medical Research Council

University of Glasgow

CVR Centre for Virus Research


UKRI
Medical
Research
Council

University
of Glasgow

CVR
Centre for
Virus Research


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# WELCOME TO THE CVR!

We are excited to welcome you to the CVR community.

The CVR is home to the largest concentration of virologists working in the UK on human viruses and viruses at the human-animal interface. We are all fascinated by viruses and investigate them from lots of different perspectives. You will have the opportunity to talk to clinicians, molecular virologists, vector biologists, bioinformaticians, cell biologists, mathematicians and structural biologists who all work together to address fundamental questions on viral disease with the ultimate goal to improve global health.

Nurturing the next generation of leaders in virology is a key mission of the CVR and we hope you enjoy your time in our community. Good luck in this next step of your career journey!

**Professor Massimo Palmarini**
CVR Director

Welcome to being a postgraduate researcher at the CVR!

You are about to begin an apprenticeship in research that will channel the skills, knowledge and enthusiasm you've acquired so far into a project which uncovers completely new things about how the world works.

In the CVR, you will join a community who approach medically relevant viruses from almost every possible angle, allowing you to tackle important problems in ambitious and creative ways. Your work here in Glasgow will, in one way or another, change the world. The skills, leadership, resilience, and friends that you acquire along the way will change you. We're here to support you on this challenging and exciting journey. We can't wait to see what you do now that you're here.

**Dr Ed Hutchinson**
CVR Postgraduate Research Convenor

# GETTING STARTED AS A PGR AT THE CVR

- [ ] Set expectations with your supervisors
- [ ] Try the food available at The Barn
- [ ] Identify quiet spaces available for you to use
- [ ] Download the safe zone app (*see page 35*)
- [ ] ----------
- [ ] Check out the things you can get involved with at the CVR (*see page 36*)
- [ ] Complete your required initial online and in-person training
- [ ] Identify travel options to get to the Gilmorehill Campus (*see page 38*)
- [ ] Meet your community (*see page 32*)
- [ ] ----------

# ADVICE FROM OUR CURRENT STUDENTS

## Mental Health and Wellbeing

1

- Maintain a work-life balance and make time for activities you enjoy.
- Remember to take your holidays (8 weeks per year)!!
- Second year blues are a real thing. The PhD journey is long and has its ups and downs. Make the most of the resources available to you and know that you can get through this!
- Feeling sick from anxiety or losing interest in activities is not normal. If this does happen to you please seek help early - you are not alone and there is no shame in it.

## Self-Confidence and Ownership

2

- Believe in yourself; you can complete your PhD.
- Your project is your own, not your supervisor's; you decide its direction and experiments. Your supervisor is there to guide you, not control your project.
- Make sure you own your PhD; it's an opportunity to work on research you're passionate about and your supervisors are there to support you in this endeavour.

## Lab and PI Selection

3

- Research your potential PI and lab environment before making a decision. Talk to PGRs, post-docs and technical staff working in the labs to get their honest opinions.
- A good lab group is crucial, more important even than a good project. So much of your PGR experience will be dictated by the people you work with, so you need to find an environment in which you work well, feel comfortable, and are valued and respected. Remember that what works for other people may not be the best fit for you.
- Use rotations to find a lab environment that you're comfortable in, the rotations are not about data collection and no PI should be pressuring you to collect lots of data during this time.
- For CVR DTP students, the first rotation is short (~2 months), and the second rotation is longer (~4 months).

## Research and Skill Development

- Use the first two years of your PhD to develop your skills (lab techniques, but also time-management, etc).
- Use reference management tools like EndNote from the beginning.
- Learn to prioritise experiments. Doing the exciting new experiments isn't always right, though your PI might push for the new unseen data. Replicates can be less "fun" to do but those are the experiments that will be an actual figure in your papers and thesis.
- Make detailed notes of everything you do and why you did it, and write materials and methods as you go. A year down the line you will have forgotten.

4

## Communication and Support

- Don't hesitate to ask questions, even if they seem silly. It's OK not to know things, you're here to learn. You can save months of time with a single conversation.
- Speak out or ask for support if something is wrong; don't suffer in silence.
- Seek advice from current PGRs and post-docs before choosing a lab.
- Make sure to have backup plans for your project in case your primary research direction encounters difficulties.

5

## Project Flexibility and Goals

- It's okay if your project changes; follow interesting data. Most of us have changed projects/directions throughout our time as a PGR.
- When you set out project goals, think carefully and speak to people with more experience so you can decide what needs to happen for that goal to be successful.

6

## Academic Responsibilities

- The Literature Review and APR are not graded and you won't be kicked out of your PhD if you don't do it "well"; they help you reflect on your progress.
- Try not to compare yourself to others; focus on your own journey.

7

## Lab Experience

8

- Things go wrong all the time. Science doesn't work a lot of the time. It's usually not you, try to take it in your stride and learn what you can from it.
- Not understanding things is a fundamental part of doing research, try to become comfortable with it.

## Additional Resources

9

- "Managing your Mental Health during your PhD" by Zoe J. Ayres is an excellent guidebook, which can be accessed for free online through the University of Glasgow.

## PI Constraints

10

- For most doctoral training programmes (e.g. the CVR DTP programme or the WT IIB programme), a PI who becomes primary supervisor to a PhD student in one year cannot be the primary supervisor for a student from the same programme the following year. There is no conflict between different programmes, however.

# MEET THE LAB GROUPS!

# MEET THE BIOINFORMATICS GROUP

## What are they trying to achieve?

CVR Bioinformatics is a group of computer-based researchers embedded in the CVR. We work in close alignment with the CVR′s Genomics team and together comprise the Integrative viral genomics & bioinformatics platform (iVGB). Our goal is to support CVR research by exploiting new advances in viral genomics and bioinformatics, and to support the research of the CVR Programmes and Preparedness platform. With other computer-based researchers in the CVR we form a Computational Virology group and meet regularly to discuss our research.

## What could you do?

CVR Bioinformatics supports the range of research in the CVR and members of the bioinformatics team can be included as co-supervisors to provide expert oversight of the computational or evolutionary aspects of a students projects. Students can also do entirely computer-based PhD projects and should contact the primary bioinformatics/computational supervisor they are interested in working with directly.

## What do they do?

Uniquely in the UK, our bioinformatics team are solely dedicated to virology and are experts in a wide range of topics relevant to CVR research priorities. The increasing size and complexity of data sets, coupled with the need to integrate new and existing data in order to perform meta-analyses, necessitates high levels of computational expertise. To meet this challenge the CVR Bioinformatics team has expertise in analysing next generation sequencing data, metagenomics, transcriptomics, data integration, molecular evolution and phylogenetics, machine learning, software engineering and database development.

CVR Bioinformaticians run training courses internationally and PhD students with computational skills can come along as instructors if interested.


**Did you know?**
Since the COVID-19 pandemic began in late 2019 in the Huanan Seafood market in Wuhan over 16M SARS-CoV-2 genome sequences have been generated in the global sequencing effort.

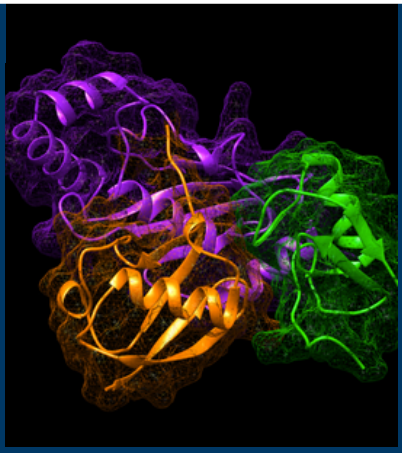
**Find out more!**
Visit the group′s website.

**Follow the team on Twitter!**
@CVRbioinfo

# MEET THE BOUTELL GROUP

## What are they trying to achieve?

We apply a multifaceted systems approach to identify key host-virus interactions that govern the regulation of host immunity and outcome of viral pathogenesis. Our group investigates these host responses to infection using a range of clinically important human pathogens, including HSV-1, MPXV, IAV, and hCOVs.



## What do they do?

We utilise a wide range of techniques to identify and functionally investigate host-virus interactions required to promote viral replication, ranging from molecular modelling, applied genomics and proteomics, to the generation and high-resolution imaging of transgenic cell lines and tissues.

## What could you do?

Delineating host responses to infection in 3D human transgenic tissues, high-resolution imaging of infected cells and tissues, repurposing of small molecule inhibitors to block virus replication and pathogenesis.


**Find out more!**

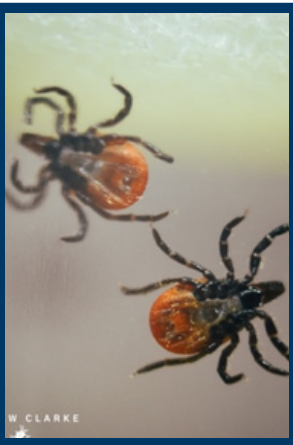
Visit the Boutell group webpage.

# MEET THE BRENNAN GROUP

## What are they trying to achieve?

Our research focuses on a specific group of emerging viruses called Phenuiviruses, found within the Bunyavirales order. The programme of work falls into the following areas:

- Examining the interaction of tick-transmitted viruses with their arthropod vector
- Developing tools and techniques to study the replication of tick-borne viruses in vivo
- Investigating the roles of the viral proteins during infection of both mammalian and arthropod cells
- Exploring the molecular determinants of virus tropism
- Developing attenuated viruses for use as potential live-attenuated vaccines or vector control agents




## What do they do?

The Brennan Lab uses virological methods such as reverse genetics technologies and acarology to probe how clinically relevant pathogens are transmitted by ticks. We seek to understand how these viruses manipulate the different cellular environments in a tick or a mammal to sustain virus replication and cause disease.

### Did you know?

Bunyaviruses are super flexible in that their genomes can be modified to create functional viruses that have 2- or 4-segments, rather than the traditional 3-segments.

## What could you do?

Projects are open for discussion in any of the areas of study above.

Even Ben's dog is involved in progressing the science and part of the lab! Archie donates his hair and scent to be used in the artificial tick feeding systems.

**Find out more!**
Visit the Brennan group webpage.

**Follow the team on Twitter!**
@brennanlab

# MEET THE CARTER GROUP

## What are they trying to achieve?

As it's famously said, that the study of viruses opens a window into all of cell biology, there's no way we will ever fully understand virus infection without understanding all its interactions with the machinery of the host cell. Cryo-CLEM/cryo-electron tomography (cryo-ET) is a powerful technique to study the complex relationships between viruses and the host cell during infection. Access to the Scottish Centre for Macromolecular Imagining (SCMI) cutting-edge instrumentation, such as the JEOL CRYO ARM 300 electron microscope and the CVR-owned Leica THUNDER Imager EM cryo-CLEM microscope allow us to perform cryogenic cryo-CLEM/cryo-ET. With new technology we can target events that happen deep in the cell so we can see more of the context of virions, including their interactions with cellular organelles. Ultimately, we want to capture the entire virus life cycle, from assembly of its pieces to maturation (with dramatic internal structural changes), to budding, to fusion with a target cell, and then through more transformations as the viral genome passages into the cell's cytoplasm, all while hijacking the host cell machinery.

## What do they do?

- Developing in situ imaging techniques to image virus infection at high-resolution using cryo-ET.
- With cryo-CLEM we capture rare infection events.
- Developing more precise correlated fluorescence and EM imaging approaches, combined with strategies to implement bright small-molecule fluorophores.
- Development of fluorescence-guided FIB milling, and montage tomography that enable us to resolve all the structures of the many intermediates of viruses during their life cycle including their interactions with cellular organelles.
- We work with a range of viruses, including Rift Valley Fever Virus, Bunyamwera virus (BUNV) and herpes simplex virus (HSV).

## What could you do?

- The creation of viral variants that contain and/or can create unnatural amino acids in their own viral proteins.
- Imaging BUNV replication factories using focused cryogenic focused ion beam (FIB) milling.
- Capturing HSV inside PML nuclear bodies using focused cryogenic focused ion beam (FIB) milling.

**Find out more!**
Visit the Carter group webpage.

# MEET THE CASTELLO GROUP

*"A virus is a piece of bad news wrapped up into proteins". Sir Peter Medawar.*

## What are they trying to achieve?

RNA is a central molecule in the viral lifecycle, acting not only as messenger (m)RNA but also as genome in the case of RNA viruses. Despite its central importance, the interactions that viral RNA establishes with the host cell remains largely unknown. My laboratory has strongly contributed to the development of new methods to profile protein-RNA interactions in virus-infected cells, leading to the discovery of a new universe of regulatory host virus interactions that remain uncharacterised. For example, recent work from our lab has shown that the exonuclease XRN1 is essential for the degradation of cellular RNAs to generate nucleotide 'bricks' to synthesise viral RNA. Ablation of the XRN1 pathway makes cells refractory to a wide range of highly cytopathic RNA viruses. This is just an example of the importance of protein-RNA interactions in virus infection.

In the Castello lab the most hated method is the plaque assay... Which is an essential technique to measure viral titre... However, we find it quite boring and we do it because we have to...

## What do they do?

The Castello lab uses a highly multidisciplinary approach, combining classic virology and molecular biology with proteomics, transcriptomics, computational biology, and super-resolution microscopy. If you chose our projects, you will be exposed to a wide range of techniques and ways to approach an experimental problem.

## What could you do?

1. How different is the viral RNA interactome across different viruses?
2. Does the viral RNA interactome changes in different hosts, cell types and in response to physiological cues (e.g. interferon) ?
3. How do cellular proteins that interact with viral RNA regulate virus infection?
4. Can these proteins be used as therapeutic targets?

## Did you know?

The piece of bad news is the 'nucleic acid' that is the heart of any virus. Some viruses can be amplified by transfection of a naked RNA molecule into cells, or even its addition to a cell free translation system (e.g. with poliovirus). Isn't it amazing?

**Find out more!**
Visit the Castello group webpage.

**Follow the team on Twitter!**
@Castello_lab

# MEET THE CLINICAL VIRAL EPIDEMIOLOGY GROUP

## What are they trying to achieve?

Our group conducts clinical and population-based studies, and combines epidemiology, immunology, in addition to genomics and bioinformatic techniques to characterise viral, host and environmental factors that determine the clinical presentation and severity of respiratory viral infections, with the aim of improving patient management and outcome, and informing policy.

## What do they do?

- Characterising the evolving epidemiology of influenza, SARS-CoV-2 & other respiratory viruses in hospitalised patients in Scotland
- Using metagenomics and target enrichment next-generation sequencing to improve aetiological characterisation of severe respiratory infections
- Elucidating viral-viral and viral-bacterial co-infections in influenza and COVID-19, and their clinical impact
- Characterising the immuno-epidemiology of SARS-CoV-2 and other priority pathogens in Malawi
- Developing optimal management pathways for hospitalised patients with severe acute respiratory illness

## What could you do?

- Multi-pathogen sero-epidemiology in a national platform in Malawi
- Impact of maternal COVID-19 vaccination on risk of SARS-CoV-2 infection in infants
- Characterising the impact of HIV & respiratory viral infection on the dynamics of nasopharyngeal microbiome in Malawian adults
- Developing a winter respiratory risk prediction model in adults in UK

Many of the group members have musical talent, be it choir, musical theatre or karaoke!

**Find out more!**
Visit the Ho group webpage.

**Follow the team on Twitter!**
@DrToniHo

# MEET THE COMPARATIVE VIROLOGY GROUP

## What are they trying to achieve?

The Comparative Virology lab works closely with the Viral Immunology lab and the Veterinary Diagnostic Service (VDS), which is a diagnostic laboratory that specialises in the detection of respiratory pathogens in veterinary samples. Together, we are uniquely and ideally placed to conduct 'One Health' studies that will improve our understanding of the significance and potential risks associated with zoonotic viral infections in companion animals.

## What do they do?

We use a One Health approach to improve our understanding of the role of companion animals in zoonotic infections, using SARS-CoV-2 as a model virus at the human-animal-environment interface. We study feline calicivirus (FCV) as a comparative model calicivirus to investigate how structural differences between avirulent and virulent clinical isolates relate to functional differences in receptor binding, viral entry and virulence. Veterinary medicine has witnessed the emergence of highly pathogenic (often fatal), virulent strains of FCV. The most notable human calicivirus is norovirus, which causes acute gastroenteritis and significantly impacts human health. Understanding the emergence of virulent caliciviruses is likely to be of great importance, with implications for the prevention and control of both human and animal calicivirus infections.

## What could you do?

- Compare the entry and replication of SARS-CoV-2 variants in human and companion animal cells.
- Assess transmission of new SARS-CoV-2 variants from humans to companion animals.
- Investigate the potential for zoonotic transmission from companion animals to humans.
- Use serological techniques to examine viral spread and identify animal reservoirs of infection.
- Investigate role of calicivirus early entry events in the pathogenesis of infection.

**Did you know?**
There are no human caliciviral vaccines and yet cats are regularly vaccinated against feline calicivirus infection.

Our lab won the Christmas party fancy dress competition in 2019 and we still have the trophy!

**Find out more!**
Visit the group webpage.

# MEET THE CRUSH TEAM

## What are they trying to achieve?

CRUSH is an antiviral drug screening and resistance platform. We are  a fully integrated translational hub of CVR that is dedicated to accelerating antiviral therapeutic discovery for SARS-CoV-2 and other high consequence viruses.

## What do they do?

CRUSH is a cost recovery-based business model with a remit to perform screening and pre-clinical evaluation of antiviral compounds in partnership with industrial and academic entities. Currently, the primary focus is on SARS-CoV-2 and related viruses, but we are extending our portfolio to include other viruses of interest. CRUSH capabilities span both in vitro and in vivo studies, including high-throughput primary drug screens, secondary screens in primary cells, drug combination studies, drug resistance assays, serological and molecular assays, and pre-clinical studies in experimental animal models. CRUSH has robotics and other equipment to perform high-throughput screens of antiviral compounds at both BSL-2 and BSL-3 settings. We engage industrial and academic partners for pre-clinical development of antiviral drugs and vaccines. CRUSH can rapidly adapt to the study of new viruses of consequence as and when they emerge. See We use a One Health approach to improve our understanding of the role of companion animals in zoonotic infections, using SARS-CoV-2 as a model virus at the human-animal-environment interface. We study feline calicivirus (FCV) as a comparative model calicivirus to investigate how structural differences between avirulent and virulent clinical isolates relate to functional differences in receptor binding, viral entry and virulence. The most notable human calicivirus is norovirus, which causes acute gastroenteritis and significantly impacts human health. Understanding the emergence of virulent caliciviruses is likely to be of great importance, with implications for the prevention and control of both human and animal calicivirus infections. for further details.

**Find out more!**
Visit the CRUSH webpage.

# MEET THE FLETCHER GROUP

## What are they trying to achieve?

We research E3 ubiquitin ligases (E3s), a diverse group of proteins that mediate substrate ubiquitination – the conjugation of the small globular protein ubiquitin to a target protein, lipid or sugar. Ubiquitin influences all aspects of subcellular biology – signaling, protein stability, localisation – and as such, E3s influence viral replication in myriad ways. It is an exciting time to be an E3-virologist because new tools are revealing an unappreciated diversity in E3 targets and mechanism. Our lab experiments at the cutting edge of ubiquitin research with general aims to 1) uncover novel E3 activities regulated by viral infection; 2) dissect the biochemistry and biology of these E3s to understand how their behaviour is related to viral replication; 3) devise ways of exploiting these E3s as research tools or therapeutic targets.

## What could you do?

- Understanding how viral RNA affects the cellular E3-ome;
- Exploring how viral-encoded E3 ligases interact with host cells;
- Dissecting the role of nucleotides in fuelling broad-spectrum antimicrobial E3s;

**Did you know?**
In this lab, we love biochemistry and molecular mechanisms as much as viral replication assays...

**Find out more!**
Visit the Fletcher Lab webpage.

**Follow the team on Twitter!**
@E3ligase

# MEET THE GENOMICS GROUP

## What are they trying to achieve?

Our lab studies viral genomes and host transcriptomes to understand the genetic makeup of viruses, including their genetic structure and diversity, and how they interact with host organisms. This is critical to identify viruses, track their evolution, respond more effectively to outbreaks and understand the mechanisms by which viral infections affect host homeostasis. To do this we use the CVR′s high throughput sequencing facility, a lab with distinct areas for specialised workflows, cutting-edge equipment, and a team of researchers exclusively dedicated to the development and implementation of high-throughput sequencing approaches applied to viruses.

## What do they do?

We are part of the integrative Viral Genomics and Bioinformatics platform and as such our approach to work is collaborative. Here are some of the projects that we will deliver in collaboration with our colleagues:

- Detecting and monitoring viruses of human consequence- using high throughput sequencing technology to identify viruses in clinical and environmental samples, and vectors.
- Benchmarking portable sequencing approaches for enhanced dengue surveillance and diagnostics in the Philippines.
- Characterising the virome of respiratory diseases of unknown aetiology.
- Employing laboratory and bioinformatic strategies to enhance the quality and accuracy of viral genomic data.
- Understanding host responses to infection at a single-cell level and with spatial resolution using single-cell and spatial transcriptomics technology.

**Did you know?**
Do you know genome sequences are being transformed into music? Scan this code if you want to hear what the genome of SARS-CoV-2 sounds like:
There is even a publication about how this web tool can be used as an alternative way to represent viral RNA function.

**Find out more!**
Visit the Genomics webpage.

**Follow the team on Twitter!**
@CVR_Genomics

# MEET THE GRAHAM GROUP

## What are they trying to achieve?

Human papillomaviruses (HPV) infect epithelial sites to cause benign disease but persistent infection can lead to cancer formation. We are dissecting the link between the HPV life cycle and epithelial biology. Understanding this link will lead to novel therapies and uncover new prognostic markers of HPV-associated disease.

## What do they do?

We are looking at how HPVs regulate the innate immune response in keratinocytes, sentinel cells of the immune system. HPV infection causes a massive change in the keratinocyte transcriptome. We are mining these changes to identify novel biomarkers of transient versus persistent HPV infection. Additionally, a medical device that emits microwaves shows significant promise in treating HPV-associated lesions. We are discovering the mechanism behind this effect using in vitro 3D culture models of HPV-associated disease. We are also testing the device in vivo in animals and human subjects.

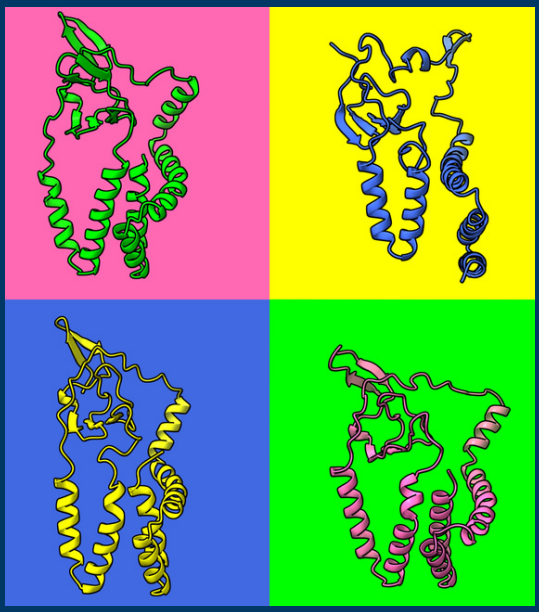
**Find out more!**
Visit the Graham Group webpage.

**Follow the team on Twitter!**
@sheilag08506645

# MEET THE GROVE GROUP

## What are they trying to achieve?

Enveloped virus particles possess specialised proteins, which are responsible for fusing viral and host membranes during entry into target cells; the most (in)famous example of one of these is Spike of SARS-CoV-2. The Grove Lab is investigating the molecular mechanics of these viral fusion machines and we are doing this in the context of two viruses, SARS-CoV-2 and hepatitis C virus (HCV). In the case of SARS-2 we have a pretty good understanding of how Spike works and we are investigating how it has been fine-tuned by evolution during the pandemic. For HCV, the fusion mechanism remains a mystery and we are trying to figure out how it works. To achieve this we are using a combination of diverse approaches including molecular virology, structural biology, artificial intelligence and advanced microscopy.



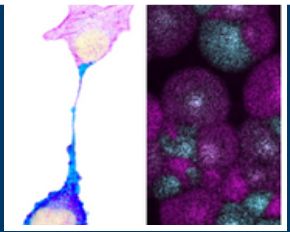
**Find out more!**
QR code for webpage and video

**Follow the team on Twitter!**
@GroveLab

# MEET THE HUTCHINSON GROUP

## What are they trying to achieve?

We are working to understand the cellular and molecular factors that make viruses infectious.
We're particularly interested in influenza viruses — partly because they are major pathogens of humans and other animals, and partly because we have really cool tools to study them with.



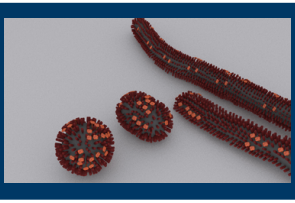
## What do they do?

Influenza viruses are important viral pathogens, but their basic biology is much more complex than standard models suggest. We use a combination of methods, including molecular virology, mass spectrometry and advanced microscopy, to understand the hidden details of how influenza viruses infect cells and establish infections within their hosts.

## What could you do?

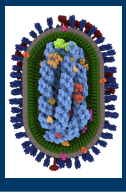
Projects include (but are not limited to):

- What is the 'ecology' of virus interactions when an infection spreads within its host?
- Can a virus exploit the changes it causes in an infected cell to maximise its infectivity?
- Why do clinical influenza isolates produce filamentous viruses that are hundreds of times longer than 'normal' virus particles?



## Did you know?

Like the dinosaurs in Jurassic Park, influenza has been brought back from extinction. To study the 1918 'Great Influenza,' one of the deadliest pandemics in history, viral sequences from a body buried in permafrost were cloned and used (very carefully) to reconstruct viruses that had disappeared eighty years previously.



We do have an unofficial lab motto, but we're not sure it's one we should publicise (it's 'Making Simple Virology Difficult Again').

**Find out more!**
Visit the Hutchinson Lab webpage.

**Follow the team on Twitter!**
@CVRHutchison

# MEET THE ILLINGWORTH GROUP

## What do they do?

We look at the rapid evolution of viruses, at what viral evolution tells us about the influences that shape the viral lifecycle, and how knowledge about evolution can help us to improve public health. We are a computational group, with work spanning everything from applied mathematics, data analysis, and evolutionary theory, in close collaboration with experimental, clinical, and public health researchers.

## What could you do?

Potential projects in my group include building a better understanding of the longer-term evolution of acute respiratory infection in immunocompromised patients, or developing and using genomic methods to understand the transmission of viruses in hospitals. Other projects which mathematical modelling or evolutionary ways of thinking, but which are conducted more directly in collaboration with other groups at the CVR, would also be available.

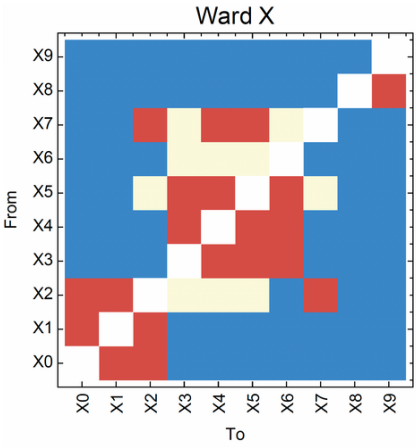
## Did you know?

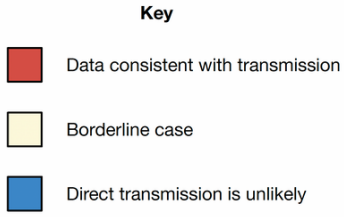
Favourite virology fact: About 7% of the human genome is made up of dead retroviruses. Human genes comprise around 2%.

"If your experiment breaks, you can turn it off and turn it on again."

Visit the group webpage:

**Follow the team on Twitter!**
@cjrilllingworth



# MEET THE JARRETT GROUP

## What are they trying to achieve?

Understand the medical importance of inherited chromosomally integrated human herpesvirus 6 (iciHHV-6). Human herpesvirus 6A and 6B (HHV-6A and 6B) are unusual among herpesviruses in that they establish latency by integrating into the telomeres of host chromosomes. Although these viruses generally infect somatic cells, HHV-6A and 6B can also infect germ cells, and this occasionally gives rise to iciHHV-6. Individuals with iciHHV-6 have one, or sometimes more, copies of the HHV-6A or 6B genome in every nucleated cell in their body and pass on the virus to offspring in a Mendelian fashion. The integrated virus is not a fossilised remnant but can fully reactivate. Although millions of people worldwide have iciHHV-6, we know very little about the consequences.

## What could you do?

- Use state of the art techniques to identify novel lineages of iciHHV-6
- Investigate whether integration into telomeres is a random event
- Determine the mechanisms(s) by which iciHHV-6 can cause or contribute to disease

## What do they do?

- Identify iciHHV-6 disease associations through screening large cohort studies, including UK Biobank
- Investigate the prevalence of iciHHV-6, and distribution of ancestral viral lineages, in different geographical locations and ethnicities
- Develop assays to improve detection and characterisation of iciHHV-6 for use in a clinical context


### Did you know?

The prevalence of iciHHV-6B in Ireland and Scotland is higher than in any place in the world investigated to date.

**Find out more!**
Visit the Jarrett group webpage:

**Follow the team on Twitter!**
@JarrettRuth

# MEET THE MURCIA GROUP

## What are they trying to achieve?

We aim to understand the processes underpinning how viruses circulate in nature: how do viruses interact with each other? How do viruses adapt to new species? What makes a host susceptible to infection? Our collaborative work with other groups at the CVR, the School of Biodiversity (University of Glasgow), the NHS, and Public Health Scotland enable us to use integrative approaches that combine experimental virology, evolutionary biology, epidemiology, mathematical modelling, clinical virology and structural virology. Our PhD projects explore the impact of cross-immunity on viral emergence, the nature of virus-virus interactions, and the biological basis of virus adaptation.

## What could you do?

- Investigate virus interactions' impact on the epidemiology of respiratory viruses and patterns of coinfections at the patient level.
- Explore interactions between influenza and respiratory syncytial virus at the cellular level, which led to the discovery of hybrid virus particles.
- Examining viral respiratory coinfections, particularly in children under five years of age, with a focus on RSV (respiratory syncytial virus) and its impact on the immune response.

## What do they do?

- Influenza Emergence: we investigate the evolution of influenza viruses, particularly swine and equine influenza viruses, at various scales. We ultra-deep sequencing to characterize the mutational spectra of within-host viral populations at the whole genome level, and sequence respiratory viruses directly from clinical specimens.
- The Virome of Disease: we are working to identify viral sequences from metagenomics data and understand viral diseases from a broader perspective, focusing on chronic obstructive pulmonary disease (COPD) and the common cold.

**Find out more!**
Visit the Murcia Lab webpage.

# MEET THE PALMARINI GROUP

## What are they trying to achieve?

We want to define the genetic barriers that animal viruses, such as avian influenza viruses, have to bypass to infect humans. In addition, we want to understand how viruses such as SARS-CoV-2 cause lesions in the respiratory tract.

## What do they do?

We use a variety of approaches both in vitro (in tissue culture), and in vivo (in animal models). We use classical molecular virology, cell biology, biochemistry, imaging, proteomics, transcriptomics, and digital pathology to understand different aspects of virus-host interactions. We always strive to correlate experimental data obtained in the laboratory in the light of virus and host evolution.

## What could you do?

Students may seek to identify new restriction factors against influenza viruses using libraries of interferon stimulated genes. Alternatively, they may unveil how the host antiviral innate immune responses vary in different areas of the respiratory tract.

**Did you know?**
There are more viruses and bacteria "living" happily in our body than cells...there are more of them in us...than us in us (I think...).

Currently, members of our lab come from 9 different countries!

**Find out more!**
Visit the Palmarini Group webpage.

# MEET THE PATEL GROUP

## What are they trying to achieve?

We are focused on conducting functional analyses of SARS-CoV-2-encoded proteins (and those encoded by related coronaviruses) using reverse genetics approaches and assessing vaccine efficacy in vaccinees. We work as part of nationwide Consortia involving the CVR groups of Professors Massimo Palmarini and David Robertson, and of several others based in different UK sites. We use both in vitro and in vivo approaches to study virus and associated pathogenesis.

## What do they do?

Phenotypic studies on SARS-CoV-2 and related coronaviruses: We have a large collection of SARS-CoV-2 viruses and related variants, isolated from clinical sources or using reverse genetics (RG) approaches. We have a very efficient RG pipeline in place which allow us to generate viruses of interest in a reasonably quick timeframe. Indeed, together with our collaborators, we published several papers describing the phenotypic impact of mutations carried by different SARS-CoV-2 variants on virus replication, host innate immune response, and on immune evasion. We use both in vitro cell-based systems, and animal models to study virus phenotype and associated pathogenesis.

## What could you do?

Our lab can offer projects on investigating functional aspects of SARS-CoV-2 or related coronaviruses and their proteins using in vitro systems and in vivo models that we already have in place.


**Find out more!**
Visit the Patel Group webpage.

# MEET THE PONDEVILLE GROUP

## What are they trying to achieve?

Using the CVR state-of-the-art CL2 and CL3 insectaries as well as modern transgenic facilities, our lab focuses on the interplays between physiology and antiviral immunity/arbovirus infection in mosquito vectors to identify the factors that shape mosquito vector competence and how they can impact on global pathogen transmission. Our research is critical for both the fundamental understanding of mosquito-borne disease emergence and the development and application of vector control strategies to block arbovirus transmission.

## What do they do?

- Analysing how induced immunity and infection impacts on mosquito fitness.
- Analysing how mosquito life traits and physiology influences antiviral immunity and vector competence.
- Characterising the importance of the interrelationships between microbiota, nutrition and host physiology.
- Developing mosquito genetic tools to study mosquito-arbovirus interactions.
- MOSAICS, a MOSquito Arbovirus omICS atlas to unravel mosquito-arbovirus interactions.
- Assessing the risk of mosquito-borne diseases in Scotland.

## What could you do?

- Assessing the efficiency of sugar feeding as a vector control measure to limit arbovirus transmission.
- Characterizing the microbiota-induced changes in sugar response and arbovirus susceptibility.
- Influence of mating and egg development on antiviral immunity and response to viral infection in the mosquito Aedes aegypti.

**Did you know?**
Drinking beer can significantly boost mosquito attraction and your risk of being bitten! This is due to ethanol ingestion upping sweat production and raising skin temperature.

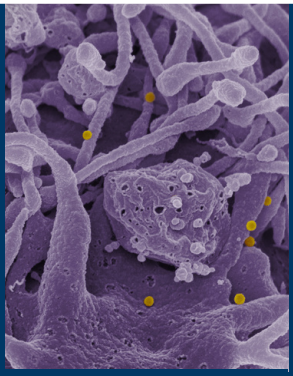
**Find out more!**
Visit the Pondeville group webpage.

**Follow the team on Twitter!**
@emipondeville
@MosquitoScot

# MEET THE PREPAREDNESS GROUP

## What are they trying to achieve?

Our research goals are to detect and characterise clinically emerging viral infections that pose a threat to human health, both in the UK and globally. This includes conducting surveillance and sequencing to identify new viral strains. We also aim to understand viral evolution and how viruses adapt under immune pressure and drug treatments.
To achieve our goals, we use cutting-edge genomic sequencing, linked clinical data and other molecular techniques to study viruses including SARS-CoV-2, MPXV, AAV2, CCHF, Ebola, and more.



## What could you do?

Investigating cross-reactivity between related orthonairoviruses in Uganda using neutralization assays and field work surveying arthropod vectors or characterize the immunopathogenesis response to AAV2-associated paediatric hepatitis cases

## What do they do?

Our lab focuses on viral evolution, vaccine development, and improving diagnosis of new viral threats. We have several major projects underway on mpox, CCHFV, SARS-CoV-2 variant sequencing and vaccine trials. We also work with our partners at the Uganda Virus Research Institute (UVRI) on novel virus discovery in undiagnosed febrile patients in Uganda.

## Did you know?

A type of virus (the 'endogenous retrovirus'), although dormant, makes up more than 8% of the human genome! There are at hundreds of thousands of mammalian viruses still to be discovered...

Our researchers come from all over the world, including the UK, Spain, India, Germany, Uganda, Benin, Thailand, Australia and the USA

**Find out more!**

**Follow the team on Twitter:**
@CVRPreparedness

# MEET THE ROBERTSON GROUP

## What are they trying to achieve?

The Robertson lab is a computational biology research group focussed on understanding virus evolution and emergence, and the specificity of virus-host relationships in the context of human disease. We study virus-host interactions and change in viral genomes to analyse and model in silico the nature of species and host 'choice' in infection, virus life cycles and determinants of cross-species transmission/host-switching. Studying these processes in viruses is important for understanding acute versus persistent infection, pathogenicity, transmission success and for predicting the emergence of new human or animal pathogens. Since the COVID-19 2020 pandemic we've been heavily focussed on the origins and evolution of SARS-CoV-2.

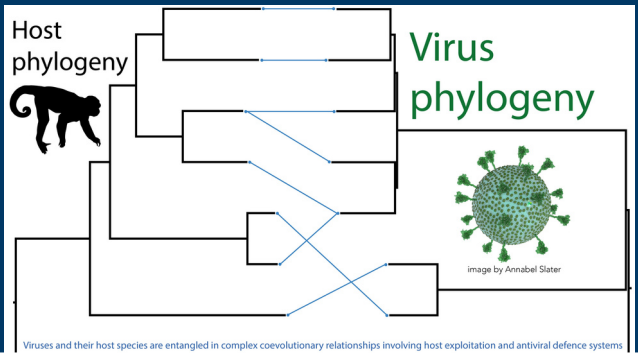
## What could you do?

We're a computational lab so are flexible in terms of projects, eg, examples include the study of virus diversity and evolution, virus-host molecular interaction networks and predicting virus evolution and host responses. A rotation or PhD project can be designed in partnership with the student and/or other University of Glasgow supervisors. A possible direction is to exploit advances in artificial intelligence, eg, protein language models, in collaboration with computer science colleagues.

## What do they do?

We take a data-driven approach to our research leveraging existing public data sets or working with experimental colleagues in the CVR, or with external collaborators to help analyse their data sets. In particular, to better understand infection and how to moderate the degree of harm they cause (virulence) we take a molecular evolutionary perspective to make inferences about where they have come from, what the risks of future emergence are, what changes are taking place in the human population, eg, the evolution of novel variants, and how virus populations evolve longitudinally in infected individuals.

The names of the first seven PhD students in the Robertson lab all began with J!




## Did you know?

While outside of infected cells viruses are mostly inert, they still evolve so under this definition viruses are very much alive. Replication and mutation are central to evolution and what's important to appreciate is viruses are just on an extreme of dependency by needing host cells to replicate. Such a parasitic lifestyle is likely to go back to early life (thought to have begun in an RNA world) and these antagonistic, sometimes cooperating, interactions have been drivers for the evolution of complexity.

**Find out more!**
Visit the group's webpage.

# MEET THE STREICKER GROUP

## What are they trying to achieve?

Our lab primarily investigates the viruses found in the common vampire bat Desmodus rotundus. We aim to understand the bat virome, the epidemiological, ecological, and other factors that influence virus transmission within bat populations and to other species, and how the transmission of rabies virus can be disrupted or prevented. We are also starting to expand into viromes of other animal species including marine mammals and non-human primates.

## What could you do?

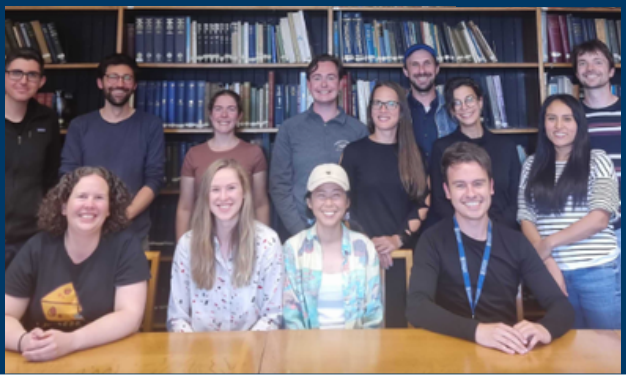
Wet lab: Evaluating the cross-species transmission potential of bat viruses using mammalian cell lines. Multiplex PCR development and Nanopore sequencing for high throughput epigenetic ageing of bats.

Dry lab: Mining metagenomic datasets for host genetic data and diet data. Spatial analysis of animal movement data. Modelling of rabies vaccines.

## What do they do?

Our lab spans from field work in South and Central America (catching and sampling wild bats; GPS tracking; setting up a captive colony), to lab work (next-generation sequencing; cell/virus culture; antibody detection techniques) to computer analysis (mechanistic and spatial modelling; machine learning).

**Did you know?**
The incubation period of rabies can vary from a matter of days, to several years.



Our office is full of bat decorations at all times of year, not just Halloween!

**Find out more!**
Visit the Streicker Group webpage.

**Follow the team on Twitter!**
@BatsGoViral

# MEET THE VIRAL IMMUNOLOGY GROUP

## What are they trying to achieve?

We investigate the immunopathogenesis of viral diseases, the immune response to viral infection and the mechanisms of action of viral vaccines. Using cutting-edge techniques, we study antibody responses to viruses, identifying the determinants on viral proteins that are targeted by virus neutralising antibodies. By measuring the antibody response to infection, we can model the way viruses spread in a population, to identify potential reservoirs of infection and predict immunity levels in the community. Our studies apply to viruses of both humans and animals.


## What could you do?

- Develop assay techniques with which hazardous viruses can be studied safely at low containment.
- Conduct serological surveys of human and animal pathogens for emerging and escalating viral pathogens.
- Study the viral entry process in cell culture-based systems.

## What do they do?

- Investigate the correlates of immunity in “at-risk populations”, for example the elderly, immunosuppressed of young children.
- Map the determinants on viral proteins that render some viral variants immune-evasive, or which confer immunity to subsequent infection following vaccination or infection.
- Assess levels of viral exposure in diverse animal hosts, identifying potential reservoirs of infection and potential sources of zoonotic transmission.

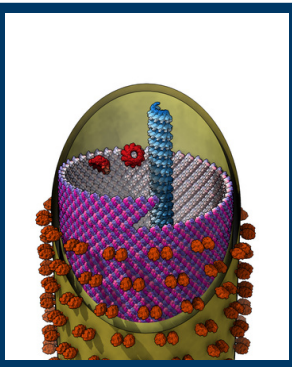
**Did you know?**
Before he demonstrated experimentally that vaccination with cowpox virus protected against smallpox, Edward Jenner was the first researcher to show that new-hatched cuckoo chicks ejected the eggs of the host species from the nest.

**Find out more!**
Visit the group’s webpage.

# MEET THE VIRUS STRUCTURE GROUP

## What are they trying to achieve?

We aim to dissect viral replicative processes using structural and biophysical methods. Specifically, we use cryo-electron microscopy and cryo-electron tomography to determine the structures of macromolecular complexes, such as capsids and whole virions, replicative complexes, and isolated viral proteins, for example, fusion proteins of enveloped viruses. By determining the structures of such macromolecular complexes, either in isolation or interacting with host-proteins, we can investigate critical aspcts of virus biology, such as entry, genome replication and virion assembly.

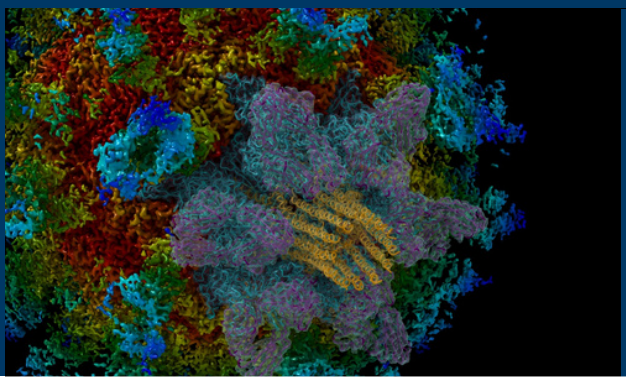


## What could you do?

- Understanding the maturation of SARS-CoV2 fusion protein. We will use cryo-EM and biophysical methods to investigate the proteolytic maturation of the spike protein.
- How to filamentous RSV virions assemble? We will use cryo-electron tomography to investigate how matrix proteins drive the assembly of these complex enveloped virions at the plasma membrane.

## What do they do?

The virus structure group has diverse interests that span the virosphere. As part of the virion structure and function programme we have a strong interest in the enveloped respiratory viruses: influenza A virus (IAV), respiratory syncytial virus (RSV) and severe acute respiratory syndrome coronavirus 2 (SARS-CoV2). For these viruses we have projects investigating structure and function of virions, nucleocapsid, and the fusion proteins SARS-CoV2 spike protein (S) and IAV haemagglutinin (HA). The group also has a long-standing interest in calicivirus entry, having made significant discoveries informing our understanding of the genome delivery mechanism of this important virus family, which includes the noroviruses.



**Find out more!**
Visit the group's webpage to find out more.

**Follow the team on Twitter!**
@Davidbhella

# USEFUL PEOPLE TO MEET

Make sure you meet other people who will be important to your time here. These include:

| | | |
|---|---|---|
| The other PGR students in your cohort. | Front of house staff (usually in the main reception office): David Cummings, Fiona Sinclair, Derek McAllister, Paul Hendry, Ronald Thompson, Alan Greer | Staff who clean your office and lab spaces |

| | | | |
|---|---|---|---|
| **Ed Hutchinson**, PGR Convenor | **Stephane Charrier,** PGR Support officer | Your PGR Rep: **Hollie Jackson-Ireland** | Your floor coordinators |

Our staff members are here to help you. This is who you should speak to about different topics:

**Donna Macpherson** (Business Manager)
Member of the CVR Management Group with responsibility of overseeing admin support for the CVR including Finance and HR requirements. Works closely with Fiona, Evelyn, Sandra, Michelle, Anne and Mel.

**Evelyn McIntosh** (Finance Assistant/Purchasing Officer)
Approach Evelyn if you have questions about purchasing goods and services, conference registration, claiming incidental travel expenses.

**Fiona Graham** (HR Assistant and Office Supervisor)
For anything relating to HR/PGR/General Administration and wellbeing support. Fiona is also a Mental Health First Aider.

**Parini Mankad (**Research Manager)
Parini sits on the CVR Management Group and has oversight of the delivery of the CVR research strategy and Equality, Diversity, and Inclusion activities. Speak to Parini about all things related to research, culture, and EDI / Athena SWAN.

**Linda Rushworth** (Research Support Coordinator)
Approach Linda if you have questions about applying for funding (of any kind), or would like to know about career development opportunities or EDI / Athena SWAN related activities. Linda is also our open access champion, she can help with information about publications.

# USEFUL PEOPLE TO MEET

**Lois Mason** (Communications and Engagement Coordinator)
Chat to Lois if you would like to develop your communication and engagement skills, promote your work or publications, or if you want to take part in the engagement activities and projects hosted by the CVR.

**Sandra Lyden** (PA to the Director)
Sandra supports Massimo in his role as Director of the CVR and also provides administrative support to the CVR Management Team and PIs.

**Anne Catchpole** and **Melanie Ferguson** (Reception and Admin Assistants)
Approach Mel or Anne if you require help with the sending of samples via couriers, room bookings, taxis and general information/support.

**Claire MacDonald** (CRUSH Business Development & Liaison Manager)
Contact Claire if you would like to work with the CRUSH team or with any external industrial partner on a research project.

**Joyce Mitchell** (CL3 Manager and Safety Coordinator)
Speak to Joyce if you have any health and safety concerns, including 'near misses' (we operate on a 'no-blame' H&S culture - if you're concerned it is always best to discuss an event, even if you happened to be the cause of it).

**Aude Aumeunier** (Biological Safety Manager)
Speak to Aude if you have any safety concerns about biological material. (Again, we operate a no-blame culture, so don't feel concerned about discussing things.)

**Linda McMonagle** (Head of Operations)
Speak to Linda if you have any operational enquiries relating to the general and specialist labs or if you need to report anything relating to the building services, offices, equipment, infrastructure or security.

**Michelle Pearson**
Approach Michelle for enquiries about stock in the Urquhart Store, submitting orders via e-catalogues and for conference registration.

# STUDENT WELLBEING & INCLUSION

**The CVR has six mental health first aiders:**

**Fiona Graham**

**Andy Stevenson**

**Aislynn Taggart**

**Steph Rainey**

**Colin Loney**

**Ed Hutchinson**

## UofG Services

### Student Wellbeing and Inclusion

#### Disability Services

For students with mental health conditions, ongoing medical conditions, learning differences, neurodivergence or a visual, hearing or mobility impairment.

Find out more and register here:

#### Chaplaincy

For supportive conversations and spiritual care, opportunities to explore faith and belief and services of worship and prayer

**chaplaincy@glasgow.ac.uk**
Call +44 (0) 141 330 5419
Visit the webpages:

#### Counselling & Wellbeing Service

Visit the UofG webpage for links to the support, services and resources available to you.

**studentcounselling@glasgow.ac.uk**
Call: +44 (0) 141 330 4528 or 7144

Visit the Researcher Development webpages to find out how the team can enrich your skills and accelerate your prospects.

**Please reach out if you are ever struggling.**

# KEY INFORMATION

## Key Links

| MVLS PGR student info | MVLS PGR noticeboard | PGR Student Handbook | UofG Student Support Services | UofG Life App | SafeZone App |
|---|---|---|---|---|---|

## Key Dates and Deadlines (Year 1)

| | |
|---|---|
| **By Month 2** | Complete the training needs assessment (TNA) and review it with your supervisor. Appoint at least one second supervisor, and two assessors (these can be updated later, particularly for rotation students). |
| **By Month 3** | Initial Review, including a literature review. If you are doing rotations the literature review may not align with your long-term plans. *This is fine* - its main aim is to help you assess how you are settling in to this style of work. (Just try to write it on something as useful to you as possible.) |
| **By Month 9** | Annual review. This formal process helps you to ensure that you are on track to complete your research as planned. Note that you cannot progress to the next academic session until an annual review has been completed, so it is important that you do complete this on time, every year. The responsibility for arranging this rests with you. |

## Who to ask for support

These people can provide help directly, can signpost other university services and can help you navigate university procedures.

- Your supervisor
- Your second supervisor
- Your assessors
- The CVR PGR Convenor (Ed Hutchinson) or the Sii PGR Convenor (Richard Burchmore)
- The CVR HR team (Donna Macpherson & Fiona Graham)

# KEY INFORMATION

## General Virology Textbooks

There are a number of standard undergraduate virology textbooks. If you need to go over a general topic in virology, Flint *et al*. ***Principles of Virology*** is very well-written. (Some of the core content of Flint is used in Vincent Raccaniello's virology lectures, which are available online.) For detailed background on specific (mammalian) virus families, the standard reference book is ***Fields Virology***.
Many of the PIs have copies of both of these and will lend them to you if you ask nicely and promise to give them back. *Fields* – an enormous multi-volume book – is also available more conveniently online through the UofG library.

## Summaries of the structure and genetics of specific viruses

**ViralZone**: http://viralzone.expasy.org/
**International Committee for the Taxonomy of Viruses:** https://ictv.global/
Specific virus families are often well-summarised in the ICTV taxonomy profiles (an ongoing series of articles in the *Journal of General Virology*) and (whisper it) on Wikipedia.

## Podcasts

A good way to keep up with general virology is **This Week in Virology** - http://www.microbe.tv/twiv/ (the same team also produce podcasts on other areas of microbiology).

For broader discussions about how to think creatively in science, **The Night Science** podcast is an ongoing series of interviews with interesting scientists (mainly biologists) about where they get their ideas from.

# PUBLIC ENGAGEMENT AND SCIENCE COMMUNICATION

The purpose of public engagement and communication at the CVR is to build a research culture that values and supports connections with wider society.
We achieve this through training and empowerment of our staff and students, developing opportunities to connect with diverse audiences and working to sustain relationships with specific groups for mutual benefit. We aim for the CVR to be recognised as a beacon for dialogue and a trusted messenger around how viruses impact on global health.

## What could you do?


Science festivals


Widening Participation


Workshops


Digital content creation

## Our Public Engagement Projects

What makes viruses tick?

Unseen Hands

BatsGoViral

## Science Communication at the CVR

**Research Goes Viral (RGV)** is a digital science communication platform hosted by the incredible CVR Staff and Students. You can watch or listen to our insightful podcast, read our interesting blog posts and explore our content created to celebrate awareness days.

Research goes Viral

Get involved with RGV to build your confidence with SciComm and create content to help your CV stand out and reach your audiences.

**Explore our CVR Engagement website and RGV.**

**Sign up here to find out about opportunities to get involved!**

# WHAT'S GOING ON AT THE CVR

**You are part of our CVR community: make sure you get involved with the seminars, events, meetings, sports groups and committees that are happening here.**

**Seminars**
- Internal Seminars
- External Seminars
- *Ad Hoc* Seminars

**Events**
- PGR Monday Brainfood and Breakthroughs
- CVR Coffee Mornings
- Wellbeing Walks
- PGR Away Day
- Phoenix Bar and Monthly Quiz
- Seasonal Parties

**Meetings**
- Computational Virology Meetings
- CVR Equality, Diversity and Inclusion Forum
- CVR Community Meetings
- CVR ADHD Support Group

**Workshops**
- Glasgow Virology Workshop
- Bioinformatics Workshop

**Committees**
- Social Committee

**Internal Communications**
- CVR Newsletter
- Sii SWAY Newsletter

**Sports Groups**
- Table Football
- Football
- Volleyball
- University of Glasgow Sports Centre

**Awards**
- Sir Michael Stoker Award (you choose who to invite)
- CVR Travel Award (you can apply for conference funds)

# LETTER TO YOUR FUTURE SELF

**As you're about to start your PhD journey, write a letter to your future self reflecting on the achievements and changes you hope to see in your life by that time. What career aspirations, personal growth, or new adventures do you anticipate? Share your dreams and goals for the future.**

# MAP OF THE CVR

**Take some time to get your bearings around the CVR, Garscube Campus and beyond.**

The UofG Life App (*see page 33*) includes features such as a comprehensive map, room finder and detailed directions.

Visit the UofG webpage maps for details descriptions:

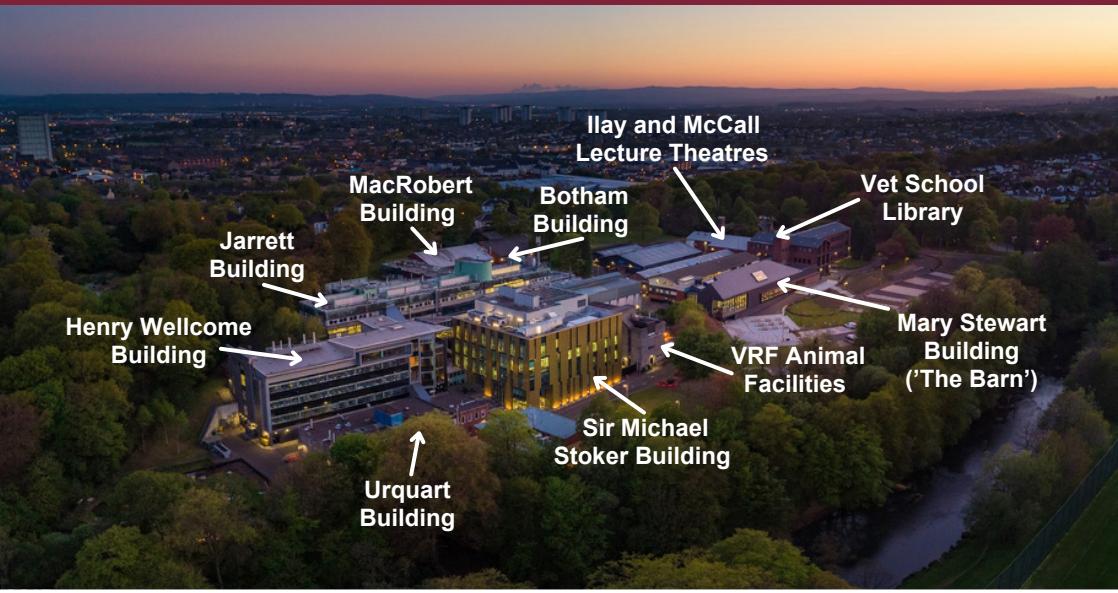
**Transport and Safety information**

Use this QR code to find safe walking and cycling routes between the Garscube and Gilmorehill campuses.

If you're working unsociable hours you can use the SafeZone App to arrange an automatic check in from campus security.

If your work requires you to travel to or from campus at a time when you don't feel you have safe transport options, a taxi is a reasonable research expense (Anne and Mel can book this for you).

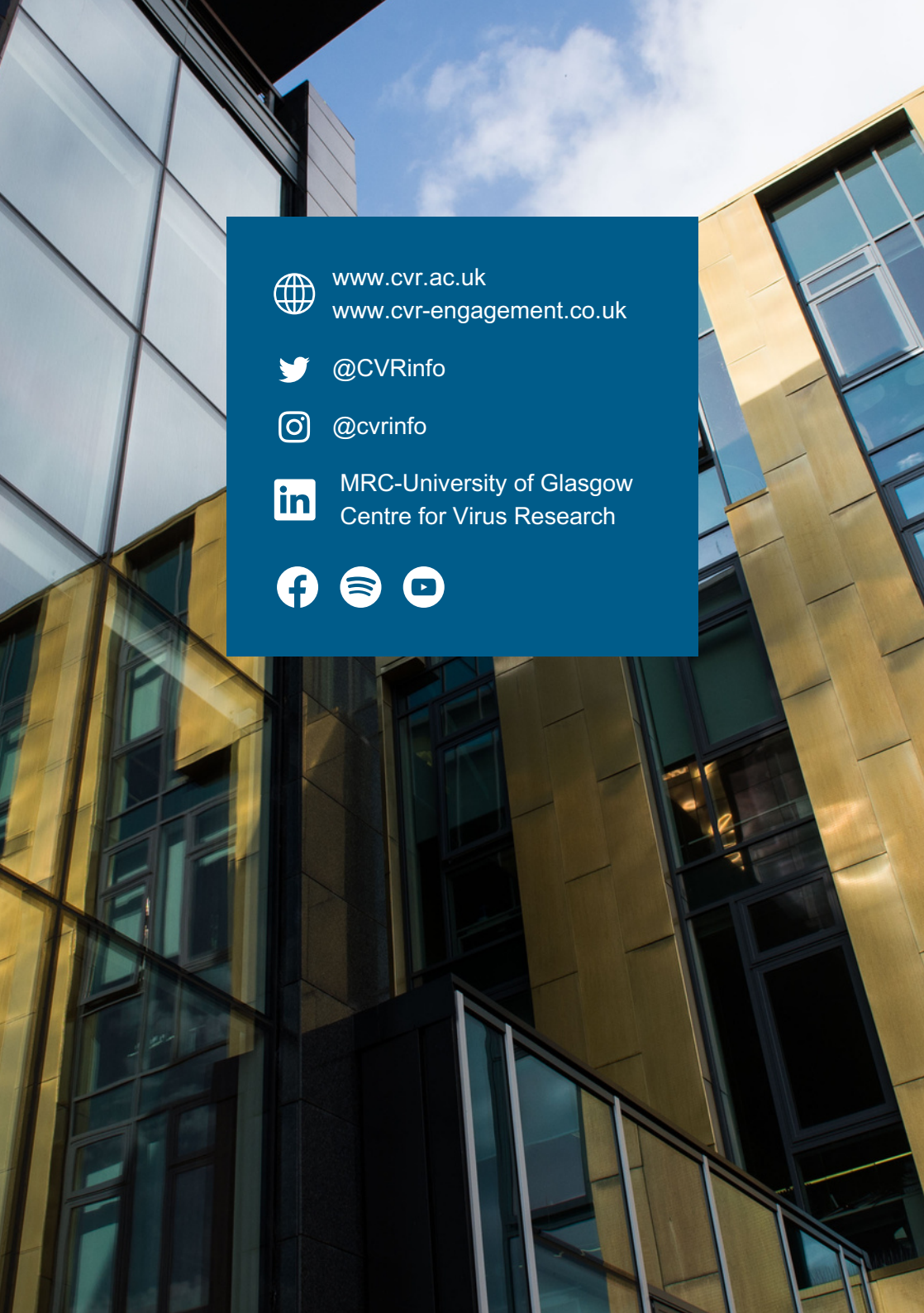
For help (or emergency services), Garscube Campus Security is on 0141 330 2222 (ext 2222)




UKRI
Medical
Research
Council

University
of Glasgow

CVR
Centre for
Virus Research



www.cvr.ac.uk
www.cvr-engagement.co.uk

@CVRinfo

@cvrinfo

MRC-University of Glasgow
Centre for Virus Research