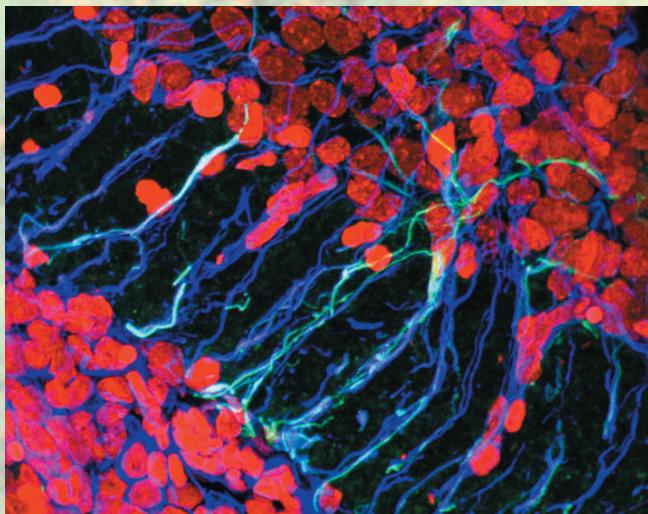




NEUROSCIENCE

NEUROSCIENCE

Neuroscience research in UCC comprises coherently linked projects in the fields of development, sensory mechanisms, neural plasticity, repair, degeneration, regeneration, and disease pathogenesis and progression. It ranges from fundamental studies of the nervous system in health and disease, to development of strategies for neuroprotection, neuroregeneration and restoration of function of damaged tissue in disorders such as Alzheimer's disease (AD), Huntington's disease (HD), multiple sclerosis (MS), Parkinson's disease (PD), spinocerebellar ataxias, retinitis pigmentosa (RP) and glaucoma. Studies also encompass the genetic background of nervous disorders such as restless legs syndrome, as well as the pathophysiology of psychiatric disorders such as depression, anxiety and drug dependence. Experimental programmes entail integrated studies involving in vitro and in vivo experimentation, which is approached at the genetic, molecular, cellular, tissue and behavioural levels. Research is carried out in Cork University Hospital, the School of Pharmacy, School of Clinical Therapies, and in the BioSciences Institute, a busy and dynamic research environment where teamwork is considered central to the work ethos. National and international collaborations are extensive.



Diving cells (red) and radial glial processes (blue) in the embryonic spinal cord

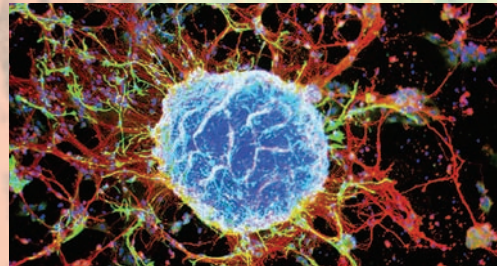
RESEARCH TOPICS:

DEVELOPMENT AND NEURAL PLASTICITY

- Neurogenesis, gliogenesis and glial-neuronal interactions at morphological and molecular levels in the developing and adult CNS
- Apoptotic and cell survival signalling during brain and retinal development
- Molecular mechanisms underlying neural circuit formation / plasticity
- The genetics of the autistic spectrum disorders

SENSORY MECHANISMS

- Molecular basis of thermal sensing in cold and warm receptors
- Transduction of painful cold
- Peripheral mechanisms underlying chronic pain after nerve injury and inflammation



A neurosphere or 'clump' of neural stem cells composed of cell bodies (blue), astrocytes (red) and neurons (green)

NEURODEGENERATION IN IN VITRO AND IN VIVO MODELS OF DEGENERATIVE DISORDERS

- Molecular and pathological mechanisms of neuronal and glial cell death in PD, AD, HD, RP, glaucoma and MS
- Characterisation of the cell biology of known pathogenic molecules and discovery of novel pathogenic molecules in AD, PD and retinal degeneration
- Characterisation of the role, and functional interplay of growth factor and cytokine signal transduction in PD and AD pathogenesis
- Understanding the cell biology and function of genes that cause AD and PD
- Molecular events during and after induction of photoreceptor and ganglion cell apoptosis in blinding retinal disorders such as PR and glaucoma
- Pathophysiological function of presenilins and secretases in the onset and progression of AD
- Evaluating the use of gene silencing, antioxidants and small molecule inhibitors as therapeutics in the treatment of retinal degeneration

REGENERATION, NEUROPROTECTION AND THERAPEUTICS

- Developing novel mechanisms for promoting CNS axon regeneration and cellular repair following axonal injury and neuronal damage, including manipulation of neural stem and progenitor cells
- Using in vivo models to develop cell replacement strategies and neuroprotective approaches to treating AD, PD, MS and retinal degeneration
- Optimising anti-inflammatory therapies and screening compound libraries for neuroprotection in the brain, retina and spinal cord
- Targeted disruptions of mouse apoptotic modulators to investigate therapeutic potential in retinal degenerations
- Genome-wide molecular approaches to discover novel proteins that interact with receptors involved in neurodegeneration and regeneration

PSYCHIATRY

- Understanding the neural circuitry underlying stress-related disorders such as Depression, Anxiety, drug dependence and cognitive dysfunction
- Neuroendocrine and immune studies in patients with major depression
- Brain-Gut interactions in functional gastrointestinal disorders
- Gene-Environment interactions in animal models of psychiatric illness

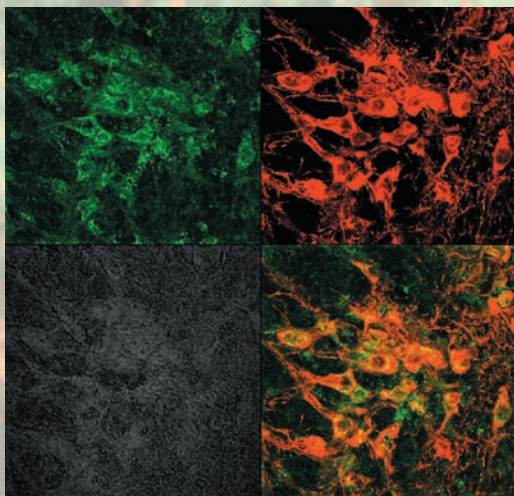
MAPPING AND IDENTIFICATION OF HUMAN DISEASE GENES

- Single gene disorders – Restless Legs Syndrome, Hereditary Spastic Paraparesis, Migraine
- Multifactorial disorders – Pain, Inflammatory Bowel Disease

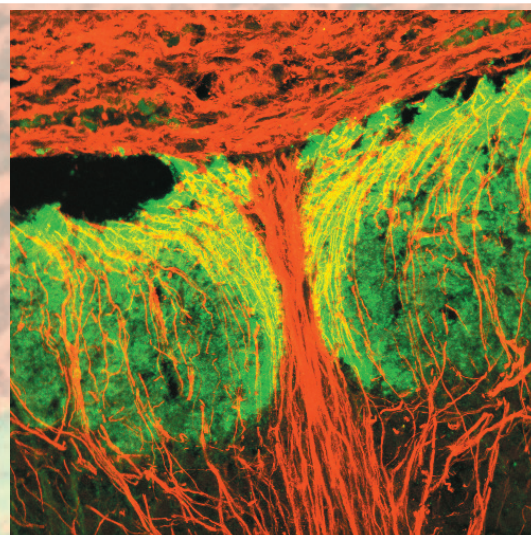
PAIN

- Characterisation, prevention and treatment of persistent post-surgical pain – identification of bio-markers for drug development and new therapeutic targets.

A marker of inflammation marker (red) is co-localised (orange) with neurons (green) in the adult brain



Axons (green) being segregated and organised by glial processes (red) in the developing spinal cord



NORMAL AND PATHOLOGICAL ADULT SPEECH AND LANGUAGE PROCESSING

- Adult neurogenic communication disorders (aphasia, dyspraxia, dysarthria) resulting from acquired brain injury (stroke, traumatic brain injury), neurodegenerative disorders (dementia, PD, HD)

DEVELOPMENT OF NEW TECHNOLOGIES

- Bio-chips in which neurones directly interface with novel silicon fabricated devices
- SLICK, a novel technology enabling in vivo genetic manipulation of fluorescently labelled neurons in transgenic mice
- Gene silencing in the brain in vivo using siRNA
- Synaptic labelling and receptor trafficking studies using lentiviral technology

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