Health and Wellbeing

> *Healthy ageing …is about having the capabilities that enable people to be and do what they have reason to value.*
>
> — World Health Organization

05

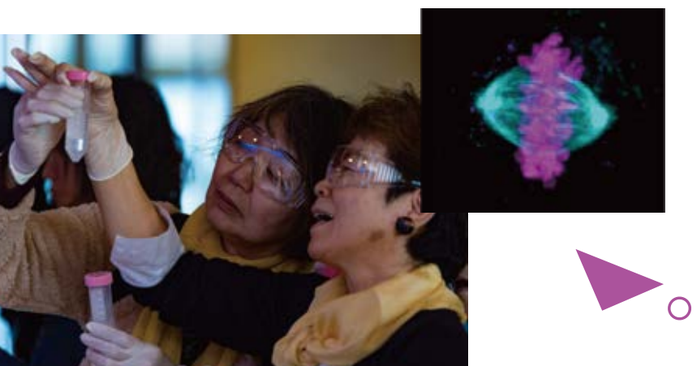
Membranology Unit

Our body contains ~37 trillion cells. Each cell is contained by a 20nm plasma membrane, thinner than a soap bubble. Cells experience a variety of damage to the plasma membrane ranging from physical attack to pathogen invasion to physiological activities such as muscle contraction. Failures within cells to respond correctly to plasma membrane damage cause devastating diseases like muscular dystrophy and Scott syndrome.

The Membranology Unit recently discovered that membrane damage can also induce *cellular senescence*, an irreversible process that causes cells to stop dividing and contributes to the ageing of an organism. Amazingly, removing senescent cells can rewind the ageing clock in animals.

The outcome of our research will ultimately contribute to developing "a treatment for ageing".

Professor
Keiko Kono



06

Neural Computational Unit

Building autonomous robots clarifies what the brain does for living in uncertain environments and reveals how adaptive algorithms can break down.

The Neural Computational Unit pursues the dual goals of developing algorithms to enable robots to learn to act by exploration and reward feedback, and understanding how human brains realize the same learning.

We develop and apply machine learning algorithms to reveal the mechanisms of mental disorders, such as childhood stress and altered brain dynamics for depression. By observing robots that learned to stay still, we came up with a hypothesis about depression and the role of serotonin in evaluation of future rewards.

We aim to integrate data from smartphones and wearable devices to empower people to monitor their own minds and bodies and take positive actions for healthy living.

Professor
Kenji Doya

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Marine Science and Climate Change

"Understanding the ocean is critical to tackling some of the greatest challenges facing the world today."

— Dr. Peter Gruss, President of OIST

01

Marine Climate Change Unit

Climate change poses a global threat to biodiversity and ecosystem function, and Earth's oceans are experiencing progressive acidification and warming. But some organisms have better capacities to adapt to profound environmental changes. If we understand how climate change affects marine species, and how quickly they might adapt or acclimatize, we could influence the fate of marine biodiversity.

The Marine Climate Change Unit works to understand how coral reef fish respond to human-induced disturbances such as climate change, heatwaves, overfishing, and urbanization.

Using the OIST Heatwave Simulator based at the Marine Science Station, we expose fish to environmental conditions that are predicted to occur in our oceans by the end of this century.

Professor
Timothy Ravasi

02

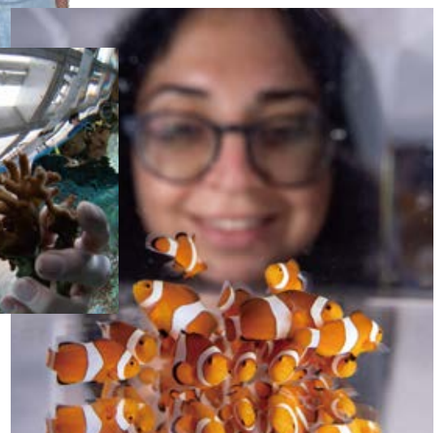
Marine Biophysics Unit

We strive to understand the resilience of marine populations to environmental changes in Okinawa and worldwide. Our work helps to promote the conservation of three unique ecosystems abundant in the waters surrounding Okinawa: coral reefs,mangrove forests and deep-sea hydrothermal vents.

The Marine Biophysics Unit studies how physical forces at play in the ocean - such as waves, currents and typhoons - affect the populations of marine organisms and how individual species shape their environment and are in turn affected by it.

Using OIST's advanced research infrastructure, we integrate fluid dynamics, biochemistry, genomics,ecology and other disciplines to understand how environmental changes affect the dynamics of marine ecosystems.

Professor
Satoshi Mitarai



Quantum Sciences

"Quantum computing use cases are getting real."

— McKinsey Digital

03

Quantum Information Science and Technology Unit

We have now entered the second quantum technology revolution. Quantum supercomputers will have enough power to solve complex problems that are otherwise intractable. At the same time, these machines could crack all security features in use by today's e-commerce.

We need to prepare to protect our data and privacy in a quantum safe way now. Yet the Ministry of the Economy, Trade and Industry has estimated a shortfall of 193,000 cybersecurity experts in Japan.

The Quantum Information Science & Technology Unit is creating an innovative environment for research and education in the field of quantum technology and cybersecurity to contribute to the future quantum ICT and its security in Japan and internationally.

Professor
Kae Nemoto

04

Quantum Machines Unit

Our understanding of the quantum realm and engineering it to our design is just beginning.

We already know that using quantum science there is the potential to build enormously fast computers – quantum computers. But there are many other potential applications.

Almost all machines made by humans are made up from interconnected parts, each doing their sub-function to enable the complete machine to achieve fantastically new abilities, for example cars, planes, computers.

The Quantum Machines Unit investigates how we could interconnect individual, sometimes very different, quantum systems, in order to achieve a new functionality that has never been encountered before.

Professor
Jason Twamley