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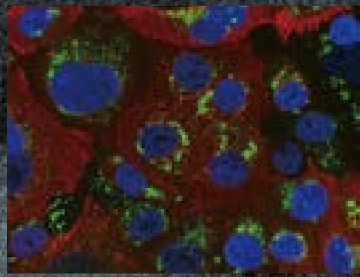
Research interests

Virology, mechanism of viral multiplication and virulence expression

Cells infected with SARS-CoV-2: the cell nuclei are shown in blue, Nsp3 proteins of the coronavirus in green, and N proteins (in the cytoplasm) in red. The photo shows the cell membranes that have collapsed, allowing adjacent cells to fuse.



Expanding universe of research into viruses… Contributing to the development of COVID-19 treatment drugs

Microorganisms are small living things that are invisible to the naked eye. Among them, viruses are particularly small. Essentially, they are genes, not cells as bacteria are. Viruses are substances made up of DNA or RNA, which are genes, combined with viral proteins.

Viruses only measure about 100nm (a 10,000th of one millimeter) on average. They are so small that to condense them in a centrifuge, they must be rotated at high speed, which is done in a special device called an ultracentrifuge. They are observed with an electron microscope because they are invisible under an optical microscope, through which an observer can naturally see objects with the eyes.

Experiments involving viruses are conducted in compliance with biosafety rules to protect researchers from inadvertent contamination. To handle SARS-CoV-2 (COVID-19-causing virus) in experiments, researchers must wear gowns and gloves and work in a P3 laboratory (P3 meaning Physical Containment Level 3). A P3 laboratory is a negative pressure room, which prevents pathogens, even if leaked within the room, from being released into the external environment.

The COVID-19 pandemic has affected many people. Perhaps some of you have been infected. It has caused many inconveniences and difficult experiences, including the obligation to wear a face mask in school and the cancellation or restriction of school trips, sports competitions, and other events.

Research on viruses is essential in producing treatment drugs and vaccines to combat viral infections. At Hiroshima University, we are engaged in the development of new drugs and the evaluation of the therapeutic efficacy of existing vaccines and medicines.

Viruses can also be used as tools. For example, AstraZeneca's vaccine for COVID-19 has been produced by modifying an adenovirus (a type of common cold-causing virus) to make a coronavirus spike protein while making it safer to prevent propagation inside the human body. Another example of a virus as a tool is the production of iPS cells, which involves inserting the four genes called "Yamanaka factors" into differentiated cells via viruses, which initializes cellular development to generate iPS cells. In this example, viruses are used as the carrier (vector).

Such applicability is interesting, but viruses in themselves are quite intriguing as well. For example, human coronavirus OC43, a virus widespread among humans as a common cold pathogen, is believed to be linked with the Russian flu, which caused a worldwide pandemic at the end of the 19th century and killed one million people. This has been revealed as a result of research into the viral genetic tree. This finding suggests the possibility that the COVID-19 virus would eventually be attenuated to become a stable presence in human society.

Viruses can multiply only when they infect cells. Studying how this occurs is also studying the functionality of cells. Considering that viruses infect animal individuals, it is also about studying how the infection expands to organs inside the body and how the immune system is related. By researching viruses, you can have an ever-expanding scope of research themes.

Background photo: An electron microscopic photo of omicron, a variant of SARS-CoV-2. The successive emergence of variants almost makes us wonder if the coronavirus has its own mind and is trying to trick or elude human efforts and immunity. In reality, however, variants result from intergenerational copying errors. The coronavirus, which has a single-chain RNA as viral genome, is susceptible to copying errors. Among numerous variants that emerge, those that are not wiped out by human efforts and immunity remain, and infections with them spread.

An ultracentrifuge is used to collect extremely lightweight viruses. The black tube containing samples is rotated at a very high speed to let viral particles settle to be separated.

Creating World Top-level Research Centers

Promising Research Initiatives

HU selects and provides priority support to promising research initiatives, which are researcher groups who have the potential to grow into independent world-class research centers (Centers of Excellence).

- International Network on Polyoxometalate Science
- Core of Research for Organelle Diseases
- Catchment Healthy Cycle between urban and rural in Setouchi to Asia, toward the creation (HURu-SAto)
- MBR Center

Creation of new academic field for the healthy cycle between urban and rural area in Asia

The center for the "Catchment Healthy Cycle between urban and rural in Setouchi to Asia, toward the creation (HURu-SAto)" aims to create healthy circulation (including people and food) between cities and their surroundings in Asia, where urbanization is progressing. Based on the successful experience in the Seto Inland Sea basin, this center aims to create a new academic research field that will contribute to solving problems in Asian countries.