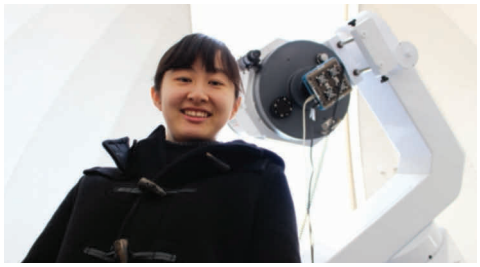

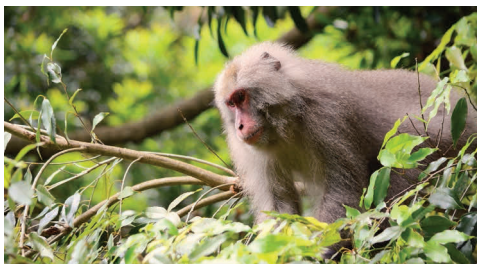

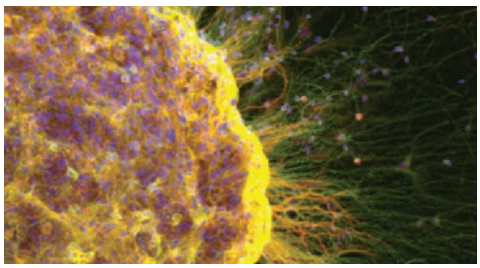

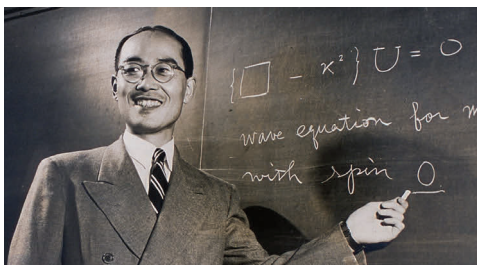

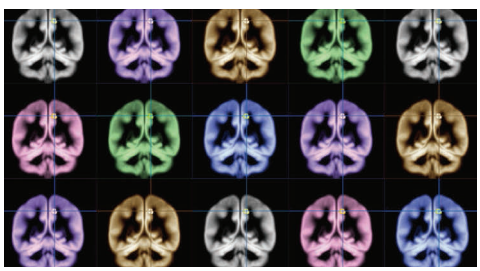

KYOTO UNIVERSITY

To wander with purpose

A tradition of unorthodox thinking has defined Kyoto University over its 120-year history. The freedom to explore unconventional ideas allows cutting-edge science to flourish at the institution.

President Juichi Yamagiwa's ambition is to keep Kyoto University a safe haven for free thinking: free from societal pressures, free from prejudice and free from existing paradigms.

"In present-day Japan, people tend to be treated harshly when they think outside the box," Yamagiwa observes. "Universities should protect students and researchers from that. Free thinking arising from the liberal atmosphere here helps pioneer the future."

Many come to Kyoto for the opportunity to conceive and explore radical ideas. They include physicist Hideki Yukawa (second photo from bottom), the first Japanese Nobel laureate, and Kitaro Nishida, who founded the Kyoto school of philosophy. Yamagiwa is also a pioneer, spending years in the African jungle living with gorillas and studying human evolution.

Ultimately, Yamagiwa plans to make Kyoto an incubator for 'frontier science' — progressive research based on interdisciplinary communication. "Frontier science should transcend national borders and also the differences between the arts and the sciences," he says, reaffirming his intention to spread Kyoto's distinctive approach to the rest of the world. "Our researchers don't just follow the cutting edge. They are the pioneers that plough the field for others to follow," he emphasizes.

Animals and technology

And plowing through the field of great ape behavior is Fumihiro Kano, who employs the latest technologies, including eye tracking and thermal sensing, to his research. In a recent study, Kano used eye-tracking technology to examine how well apes recall one-off events stored in their long-term memories. Kano's team recorded where the apes looked while viewing video clips starring a colleague dressed as a 'bad' gorilla. The results demonstrated that apes can remember events they had seen or experienced only once. "Studying animal behavior is no longer just about direct observation and long-term training," Kano explains.

Meanwhile, Kano's colleague Masaki Tomonaga has been testing the visual perception of ponies using touch screens. In his study, ponies discriminate between different shapes by nuzzling a touch screen. Comparison of these results with those of studies involving other mammals reveals that ponies see the world as humans do, he says. "New technology is developing quickly. It opens up so many options."

Peering into germ-cell development

Behavioral scientists are not the only ones finding new uses for the latest advances. Kotaro Sasaki is breaking new ground with induced pluripotent stem (iPS) cells, whose discovery led to Kyoto University's Shinya Yamanaka being awarded the 2012 Nobel Prize in Physiology or Medicine.

Pluripotent stem cells have been used to generate just about every cell type in the body except germ cells, which include sperm and ova. Unlike other stem-cell-based therapies, which affect only the patient, those that induce germ cells could also benefit the patient's offspring.

Germ cells are difficult to study because of the ethical and technical issues involved in experimentation. "When I read about his

work, I knew I had to come back to Japan," says Sasaki, referring to the work of lab leader Mitinori Saitou. Sasaki, who was a renowned pathologist in the United States, returned to join Saitou's team in Kyoto.

Sasaki spent a month at the Center for iPS Research and Application learning how to work with human iPS cells and about the developmental process of human germ cells. In addition to illustrating key transcription interactions and signaling events, Sasaki gained insight into how epigenetic marks — traits that are inherited without changes to the DNA sequence — are 'erased' at the beginning of germ-cell development.

The team's model, still in its early stages, may form a foundation for continuing studies on germ cell lineage. "By further reconstituting human germ-cell development in vitro," explains Saitou, "we may be able to elucidate the mechanisms throughout the developmental process, from embryo to adult."

'Seeing' black holes with visible light

In the field of astronomy, Mariko Kimura (second photo from top on facing page), a master's student, took full advantage of Kyoto University's international network when she witnessed a major event unfold in front of her eyes.

Kimura called affiliated astronomers when the binary black-hole system V404 Cygni generated an outburst, an event that occurs only a few times a century. Within minutes, she had international collaborators supporting her with unprecedented amounts of observational data. "We now know that we can make observations based on optical rays — visible light, in other words — and that black holes can be observed without high-spec X-ray or gamma-ray telescopes," Kimura says.

Her study indicates that the main factor triggering repetitive activity around black holes is not the quantity of mass accretion, but rather the length of orbital periods. "The study would not have come to fruition," says Daisaku Nogami, leader of the research unit, "were it not for the readily available network Kyoto astronomers have established through years of effort with a view to advancing mutual support in observation."

"Stars can only be observed after dark, and there are only so many hours each night, but by making observations from different locations around the globe we're able to gather data more comprehensively," elaborates Nogami.

Searching for where happiness happens

In Yamagiwa's haven for free thinking, other researchers delve into a question left unanswered for millennia — our own well-being.

Throughout human history, eminent scholars such as Aristotle have contemplated happiness, says Wataru Sato. He is determined to find answers with his own twist and with the help of functional magnetic resonance imaging (fMRI). "Emotions arise from our subconscious mind and spirit," says Sato. "People bond through emotions, but we can't access our subconscious minds directly. Being able to understand that part of ourselves could help us solve problems associated with the mind and spirit — including how to be happy."

At the Kokoro Research Center, scholars like Sato explore the mind and spirit, with some examining the topic from a philosophical perspective, and others, like Sato, integrating neurological insights in their studies.

President Juichi Yamagiwa

Using fMRI, Sato has identified the part of the brain that 'feels' happiness and has clarified what factors constitute happiness. According to his study, happiness is a combination of happy emotions and satisfaction with life coming together in the precuneus, a region in the medial parietal lobe that becomes active when experiencing consciousness.

For Yamagiwa, this is only the beginning. Even in the face of the uncertainty of this globalized era, Yamagiwa believes that Kyoto can lead the world with its creativity. And he is not merely talking about edgy science. "We wander in academic freedom with a purpose," Yamagiwa says. "These innovations will lead to solutions for a harmonious, sustainable, global society."

Our locations:

Kyoto University maintains research and observation centres at locations throughout Japan (pictured), from Hokkaido to Kagoshima, as well as numerous offices and facilities overseas.

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