

2025 年度
創価大学 大学院 理工学研究科【環境共生工学専攻】
博士後期課程 一般選抜試験問題

英 語

開始時刻 午前 10 時 00 分
終了時刻 午前 11 時 00 分

【注意事項】

- 解答用紙には受験番号、氏名を必ず記入してください。
- 試験終了後、答用紙は必ず提出してください（問題用紙は提出しなくてよい）。
- 配布された答案用紙を使用し、解答してください。

1 Answer all questions following a passage on the basis of what is stated or implied in that passage, either in Japanese or English.

After a year of rising bird flu cases among people in the United States, researchers are keeping a watchful eye on the H5N1 virus to slow further spread.

Since early 2024, the country has recorded 66 cases of highly pathogenic avian influenza caused by H5N1. Farm workers who caught the virus from infected cattle or poultry make up most cases. The first human death related to the disease was announced January 6, but other recent illnesses have often been mild, with symptoms such as pink eye, fever and a cough.

Although the public health risk remains low, researchers worry that insufficient tracking of the virus, particularly in cattle, could increase H5N1's human pandemic potential. Government action to handle bird flu has been lackluster, scientists say, and the incoming Trump administration's views on vaccines and other policies may affect the virus's containment and course.

"It could become a pandemic tomorrow, and it could never become a pandemic. We just don't know," says virologist Angela Rasmussen of the University of Saskatchewan in Saskatoon, Canada. But "at a pandemic scale, even a 'mild' pathogen can be incredibly destructive."

Here's what bird flu experts are watching for in 2025.

About two-thirds of the recent bird flu cases in humans came from exposure to infected dairy cows. But the outbreak in cattle has yet to be contained.

The U.S. Department of Agriculture first announced finding H5N1 in dairy cows in March, although researchers suspect the outbreak began in December 2023. More than 900 herds of cattle across 16 states have now tested positive. The vast majority are in California, which declared a state of emergency last month.

That same month, the USDA began a national milk testing strategy, sampling milk from multiple cows in bulk tanks. Twenty-eight states are currently testing this way, and around two-thirds of those states have not shown any H5N1-infected cattle since March 2024. As the data come in, Rasmussen says, more states will probably have herds that test positive for the virus.

Additionally, an April order by the USDA requires dairy cattle to test negative for H5N1 prior to transportation to a new state. But plenty of within-state movement is still happening, says virologist Seema Lakdawala of Emory University in Atlanta. A temporary stay-at-farm order, at least until health officials know how widespread the outbreak is, would be ideal.

Considering an entire herd "infected" is also a flawed way of thinking, Lakdawala says. The more H5N1 jumps between cows in a herd — which can contain thousands of animals — the more opportunities it has to acquire genetic changes that make it more dangerous to humans.

Lakdawala wants to see each dairy cow get tested prior to milking, which shouldn't present a huge logistical challenge, she says. Squirtng some milk directly from a cow's udder onto a testing device — similar to a COVID-19 rapid test — could quickly uncover an infection. But the USDA either hasn't come up with a way to implement this or it hasn't gotten buy-in from farmers, Lakdawala says.

Partnering with private testing companies could help, but "there is no current strategy to isolate infected cows in a herd to reduce the transmission of this pathogen," she says.

Despite mild symptoms in most of the human H5N1 cases in the U.S., the individual who died with it — a Louisiana man over the age of 65 who had underlying medical conditions — had the country's first severe illness. Additionally, a 13-year-old girl in British Columbia, Canada needed her blood externally oxygenated, among other measures, in November after catching H5N1. She is no longer in critical condition but remains hospitalized.

These two cases hint that harsher illness may occur when the virus infects people outside the demographics of farm workers, who are often healthy young adults, Rasmussen says.

The serious illnesses also arose from the virus subtype D1.1, which is circulating in poultry and wild birds. A different subtype, called B3.13, is spreading among dairy cows. This could mean the D1.1 subtype possesses some genetic component that increases disease severity, Lakdawala notes.

Genetic analyses of the viruses from both serious cases showed mutations gained after infection that could allow H5N1 to more easily infect people. Those mutations were found in the genetic code for a protein called hemagglutinin, which helps the virus latch onto and invade cells, says virologist Jesse Bloom of the Fred Hutchinson Cancer Center in Seattle. H5N1's hemagglutinin struggles to stick to cells in the human respiratory tract, which is currently a major barrier to the virus's spread in people. Changes to the protein would probably be key to allowing person-to-person transmission, he notes.

Still, Rasmussen says, "we don't actually know how significant some of these mutations are ... Just because they do something in the lab doesn't necessarily mean that they're going to actually do that" in the real world.

Coinfections of both H5N1 and a seasonal flu virus are also worrisome. If the viruses combine their genetic pieces in a process called reassortment, that could produce a more transmissible virus, Rasmussen says. "Historically, numerous influenza pandemics, including 1918, and including the 2009 H1N1 pandemic, have been associated with a recent reassortment event."

That possibility provides another reason to get an annual flu shot, she says.

Many researchers believe that insufficient federal actions have been taken to manage bird flu thus far. Since 2022, the USDA has spent nearly \$2 billion on H5N1 measures, which includes reimbursing farms for losses. Preventatively, "it's been a pretty lackluster response," Rasmussen says.

From December 2023 to March 2024, when the USDA announced its finding of bird flu in dairy cows, the virus was spreading undetected among cattle and moving to new states, Rasmussen says. That lag time is a big reason why the outbreak is still growing, and why no one knows its extent.

Dairy farm workers need better protection, too.

“I’ve been in multiple [dairies]. What I see in terms of [personal protective equipment] are gloves, and that’s it — there’s no eye protection; there’s no mucosal protection,” such as face shields and masks, Lakdawala says. “We need to start requiring them … at these farms to reduce exposures.”

With such a high exposure risk to H5N1, dairy employees should also be offered H5 vaccines that the federal government has been stockpiling for emergencies, both Lakdawala and Rasmussen say. Around 10 million doses should be available by the end of the first quarter of 2025.

modified from source: McKenzie Prillaman, JANUARY 16, 2025, [Sciencenews](http://www.sciencenews.org/article/bird-flu-avian-flu-h5n1-virus)
www.sciencenews.org/article/bird-flu-avian-flu-h5n1-virus

- (1) Was there a ‘pandemic’ of bird flu in the US in 2024?
- (2) How many human beings died by the H5N1 in 2024 in the US and Canada?
- (3) What kind of measures are suggested to take care of dairy farm workers?
- (4) Why do dairy farm workers have to be cautious despite that it is a bird flu?
- (5) What kind of survey was made on milk and what was the result? How were the results related to the H5N1 spreading?
- (6) What is ‘hemagglutinin’ and what is its role in the infection?
- (7) What is ‘coinfections’, and why is it a concern?

[2] Answer all questions following a passage on the basis of what is stated or implied in that passage, either in Japanese or English.

Ever since its formation around 4.5 billion years ago, Earth's rotation has been gradually slowing down, and its days have gotten progressively longer as a result.

While Earth's slowdown is not noticeable on human timescales, it's enough to work significant changes over eons. One of those changes is perhaps the most significant of all, at least to us: lengthening days are linked to the oxygenation of Earth's atmosphere, according to a study from 2021.

Specifically, the blue-green algae (or cyanobacteria) that emerged and proliferated about 2.4 billion years ago would have been able to produce more oxygen as a metabolic by-product because Earth's days grew longer.

"An enduring question in Earth sciences has been how did Earth's atmosphere get its oxygen, and what factors controlled when this oxygenation took place," microbiologist Gregory Dick of the University of Michigan explained in 2021.

"Our research suggests that the rate at which Earth is spinning – in other words, its day length – may have had an important effect on the pattern and timing of Earth's oxygenation."

There are two major components to this story that, at first glance, don't seem to have a lot to do with each other. The first is that Earth's spin is slowing down.

The reason Earth's spin is slowing down is because the Moon exerts a gravitational pull on the planet, which causes a rotational deceleration since the Moon is gradually pulling away.

We know, based on the fossil record, that days were just 18 hours long 1.4 billion years ago, and half an hour shorter than they are today 70 million years ago. Evidence suggests that we're gaining 1.8 milliseconds a century.

The second component is something known as the Great Oxidation Event – when cyanobacteria emerged in such great quantities that Earth's atmosphere experienced a sharp, significant rise in oxygen.

Without this oxidation, scientists think life as we know it could not have emerged; so, although cyanobacteria may cop a bit of side-eye today, the fact is we probably wouldn't be here without them.

There's still a lot we don't know about this event, including such burning questions as why it happened when it did and not sometime earlier in Earth's history.

It took scientists working with cyanobacterial microbes to connect the dots. In the Middle Island Sinkhole in Lake Huron, microbial mats can be found that are thought to be an analog of the cyanobacteria responsible for the Great Oxidation Event.

Purple cyanobacteria that produce oxygen via photosynthesis and white microbes that metabolize sulfur, compete in a microbial mat on the lakebed.

At night, the white microbes rise to the top of the microbial mat and do their sulfur-munching thing. When day breaks, and the Sun rises high enough in the sky, the white microbes retreat and the purple cyanobacteria rise to the top.

"Now they can start to photosynthesize and produce oxygen," said geomicrobiologist Judith Klatt of the Max Planck Institute for Marine Microbiology in Germany.

"However, it takes a few hours before they really get going, there is a long lag in the morning. The cyanobacteria are rather late risers than morning persons, it seems."

This means the window of daytime in which the cyanobacteria can pump out oxygen is very limited – and it was this fact that caught the attention of oceanographer Brian Arbic of the University of Michigan. He wondered if changing day length over Earth's history had had an impact on photosynthesis.

"It's possible that a similar type of competition between microbes contributed to the delay in oxygen production on the early Earth," Klatt explained.

To demonstrate this hypothesis, the team performed experiments and measurements on the microbes, both in their natural environment and a laboratory setting. They also performed detailed modelling studies based on their results to link sunlight to microbial oxygen production, and microbial oxygen production to Earth's history.

"Intuition suggests that two 12-hour days should be similar to one 24-hour day. The sunlight rises and falls twice as fast, and the oxygen production follows in lockstep," explained marine scientist Arjun Chennu of the Leibniz Centre for Tropical Marine Research in Germany.

"But the release of oxygen from bacterial mats does not, because it is limited by the speed of molecular diffusion. This subtle uncoupling of oxygen release from sunlight is at the heart of the mechanism."

These results were incorporated into global models of oxygen levels, and the team found that lengthening days were linked to the increase in Earth's oxygen - not just the Great Oxidation Event, but another, second atmospheric oxygenation called the Neoproterozoic Oxygenation Event around 550 to 800 million years ago.

"We tie together laws of physics operating at vastly different scales, from molecular diffusion to planetary mechanics. We show that there is a fundamental link between day length and how much oxygen can be released by ground-dwelling microbes," Chennu said.

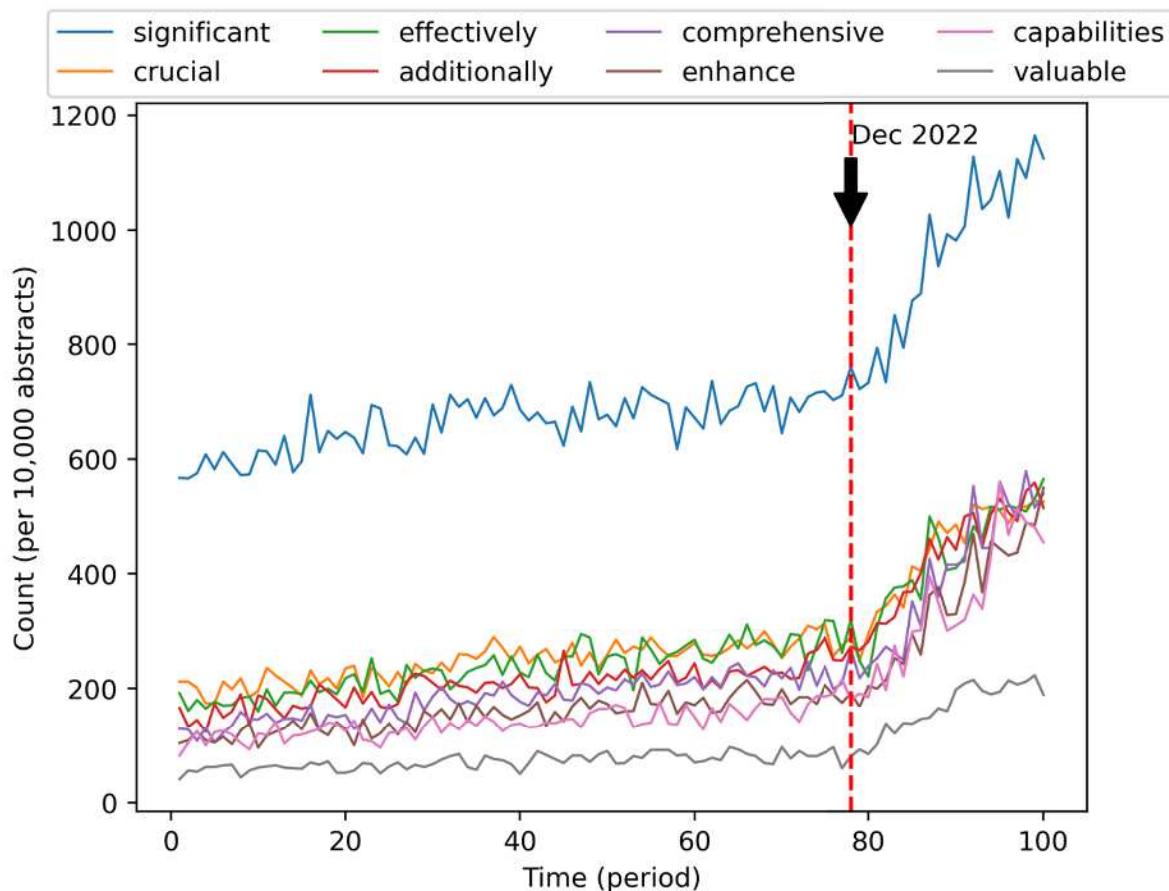
"It's pretty exciting. This way we link the dance of the molecules in the microbial mat to the dance of our planet and its Moon."

modified from source: MICHELLE STARR, 11 January 2025, Sciencealert
[/www.sciencealert.com/earths-rotation-is-slowing-down-and-could-explain-why-we-have-oxygen](http://www.sciencealert.com/earths-rotation-is-slowing-down-and-could-explain-why-we-have-oxygen)

- (1) Why is the Earth's rotation is slowing down?
- (2) What is the typical length of a day and how is it slowing down according to this paper?
- (3) How is the oxygen generation affected by the length of a day?

3 Answer the questions below in English.

1. Describe what facts are displayed in the figure, in detail.
2. Explore (free) discussion points based on the information in the figure.



background information:

arXiv is an open archive for scholarly articles maintained and operated by Cornell University. This figure was taken from a paper submitted to arXiv, entitled “Is ChatGPT Transforming Academics’ Writing Style?”, which discussed the textual density of ChatGPT’s writing style in their abstracts by means of a statistical analysis of word frequency changes based on one million arXiv papers submitted from May 2018 to January 2024. The vertical red dashed line demarcates the first time period after ChatGPT’s release.

source: M.Geng and R.Trotta. “Is ChatGPT Transforming Academics’ Writing Style?”
arXiv:2404.08627v1 [cs.CL] 12 Apr 2024