fields. Different groups can advance various hypotheses, as long as they remain open-minded, and the peer-review process can also help to promote the practice. "I think we have a duty as editors and reviewers to bring up alternatives," says Branch, "and to require authors that come up with a new hypothesis to also include alternatives when they bring it up the first time around".

Regardless of how they apply the method, many researchers say that they stumbled across the idea of multiple hypotheses by accident, as graduate students or later. Branch had never heard of the concept until a few years ago, but was so struck by it that he wrote an article last year arguing that researchers should not seek a single, universal explanation for how fisheries affect marine food webs, but should consider how different models might apply in various parts of the world[7].

A few researchers say that their advisers encouraged them to read classic philosophy-of-science texts, such as Thomas Kuhn's *Structure of Scientific Revolutions* (Univ. Chicago Press, 1962), or fostered discussions on the practical side of the scientific method at lab meetings. But many scientists can make it through their entire careers without any formal training in how to develop hypotheses.

That's too bad, because learning and applying the multiple-hypothesis method can improve the calibre of scientists' work and empower scientists themselves, says Symes, who published a guide last year on teaching the research process[8]. "It always pains me to see students who define success and failure as whether they support a particular hypothesis," she says. "Failing is not collecting the data you need. Succeeding is being able to differentiate the possibilities." ■

Julia Rosen *is a freelance writer in Portland, Oregon.*

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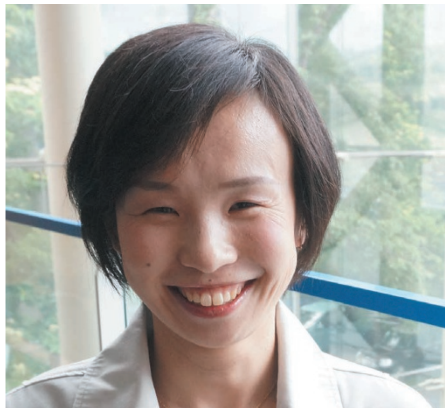
CORRECTION

The Careers Feature 'Partners in knowledge' (*Nature* **535,** 581–582; 2016) mistakenly attributed the tradition of depicting unusual events on buffalo hides to the Great Lakes region. It is actually a Great Plains tradition.

TURNING POINT
Planet navigator

Chikako Hirose, an aerospace engineer for the Japan Aerospace Exploration Agency (JAXA), led the team that steered the Akatsuki probe into orbit around Venus on 7 December 2015. She has directed Japan's only successful planetary mission so far, recovering the spacecraft from a failed insertion attempt in 2010.



What led you to become an aerospace engineer?

When I was nine years old, I learned from my schoolteacher that human beings had been to the Moon. I became curious about space. At 15, I sent out letters to many laboratories at NASA, asking for advice on how to get involved in space-related activities. I got lucky — one retired engineer from NASA's Goddard Space Flight Center replied. He told me to study hard in chemistry, physics and mathematics. When I was 19, JAXA announced that 20 students would be selected to attend the 50th International Astronautical Congress in Amsterdam, which I applied for. The opportunity eventually led to an official job offer from JAXA.

Why were you in the control room when Akatsuki failed to enter Venus's orbit in 2010?

I wanted to get involved in deep-space missions. I would go to the Akatsuki project room every day just to see if there was something I could do. Mostly, I just listened. The spacecraft was passing behind Venus when it was set to enter orbit, so we couldn't receive continuous signals. When the predicted time came, we didn't receive anything. One second passed, two, three — after 15 seconds, people were whispering, "What is happening to Akatsuki?" We found out that the main engine hadn't fired as planned, so the spacecraft had gone into safe mode and was tumbling. You could see the disappointment on the faces of the scientists.

How did you end up leading the recovery?

I had done work analysing space debris and estimating its close approach to satellites. This experience made me an expert in trajectory and orbital analysis. We determined, on the basis of the gravity of the Sun and Venus, that Akatsuki would only re-encounter Venus five years later. We tried to preserve the spacecraft as best we could. Its design life was just two and a half years.

What was the key constraint in designing Akatsuki's new trajectory?

The spacecraft's orbit had become very long and elliptical — 370,000 kilometres at its farthest distance from Venus (similar to the distance between Earth and the Moon) and 400 kilometres at its closest. At its farthest point, the spacecraft could take more than ten hours to pass through the planet's shadow. But Akatsuki's solar-charged batteries last for less than two hours. We had to adjust the spacecraft's orbit several times over five years and perform a manoeuvre so as not to exceed Akatsuki's battery life.

How confident were you that the mission would succeed?

I still didn't know whether Akatsuki's engines really worked. Our initial plan was to use the four engines on one side. If they failed, we were prepared to rotate the spacecraft 180 degrees to use the four engines on the other side. We were closely monitoring the velocity of the spacecraft, and saw that the change was exactly as expected. We knew that Akatsuki had entered into orbit around Venus.

How did you celebrate?

In 2010, we had made preparations to celebrate, but failed. In 2015, I had brought a bottle of champagne with me, but didn't tell any of my colleagues until after the operation was complete. We opened the bottle and drank it together.

Are you still involved with Akatsuki?

Yes. I am still responsible for controlling Akatsuki's orientation with respect to Venus, which changes almost every hour when the craft is closest to the planet. I also have to ensure that the spacecraft is oriented correctly for downlinking its observation data to Earth. We expect Akatsuki to survive another five years before crashing into Venus. ■

INTERVIEW BY SMRITI MALLAPATY

This interview has been edited for length and clarity.