

# How *H. pylori* Proves That Science Knowledge Changes When New Evidence Appears

## Scientific example

*Helicobacter pylori* is a Gram-negative bacterium with a spiral shape and a length of 3 µm, including its flagella.



**Figure 1.** Transmission Electron Microscope (TEM) image of *Helicobacter pylori*.<sup>3</sup>

The bacterium produces urease, an enzyme that converts urea into carbon dioxide and ammonia, allowing it to neutralize acid and thus survive in the human stomach until it colonizes the mucosa of the gastric wall.

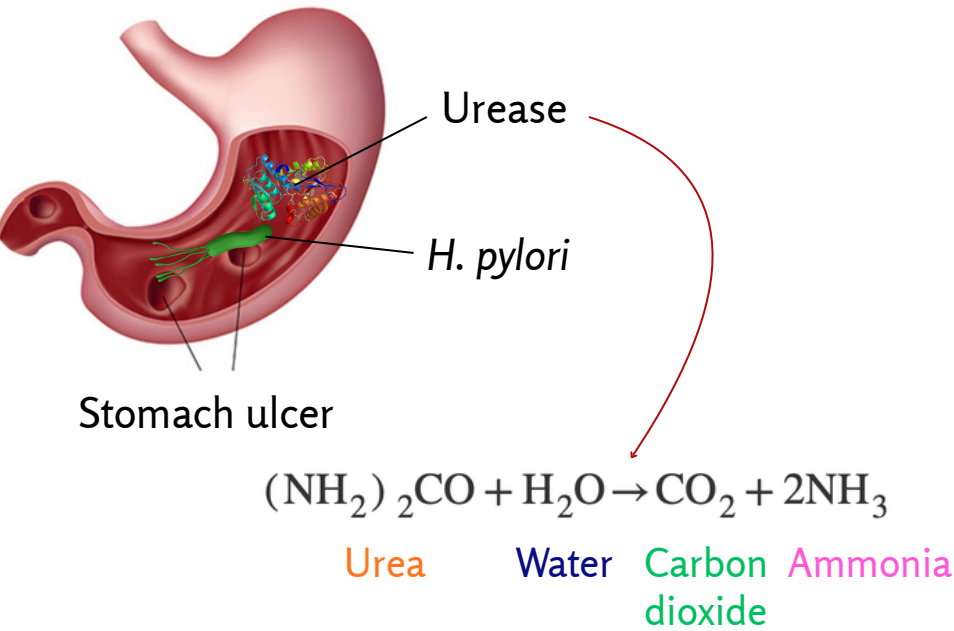


**Figure 2.** Mechanism of gastric acid neutralization by the enzyme urease in *Helicobacter pylori*.

*H. pylori* was the true cause of ulcers, even though scientists were reluctant to accept their hypothesis because the stomach's pH ranges from 1.5 to 3.5 on a fasted stomach and rises to pH 4-5 after eating. This makes it an environment far too hostile for any form of life to survive.

## Nature of Science Principle

To prove that his theory was correct, Marshall intentionally infected himself with food contaminated with *H. pylori*, after which he experienced symptoms commonly associated with ulcers in the stomach lining:

- Abdominal pain
- Nausea
- Vomiting
- Loss of appetite

After undergoing two biopsies on day 10 and an endoscopy, *H. pylori* was detected, confirming his theory; therefore, if it was an infection, it could be treated with an antibiotic. However, on day 14, he was about to begin treatment with tinidazole, but when he underwent a second endoscopy, his immune system had already eradicated the bacteria.

So, to test his hypothesis a second time, he treated his *Helicobacter*-positive patients with bismuth and metronidazole, eradicating *H. pylori* within two weeks.

This discovery earned them the 2005 Nobel Prize in Physiology or Medicine

## Why This Matters

Marshall and Warren's experiment demonstrates that science is not limited to proposing a hypothesis for debate, but rather requires experimentation and analysis of the results to reach actual conclusions. This case is fundamental because it shows how the combination of theory, data, and direct evidence made it possible to refute a deeply held belief in society. Thus, this principle is important because it helps us understand that scientific knowledge advances by challenging preconceived ideas through research and verification.

## Learning use

This case card can be used as an icebreaker or a topic for class discussion. The teacher can present the case to challenge the misconception that bacteria cannot live in the stomach, and in turn explain how enzymes facilitate their survival. This allows students to discuss the mechanism and function of enzymes

## References

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2. Marshall, B. J. & NHMRC Helicobacter pylori Research Laboratory. (2005). HELICOBACTER CONNECTIONS. In Nobel Lecture.
3. Wessner, D., Dupont, C., Charles, T., & Neufeld, J. (2017). Microbiology. John Wiley & Sons.