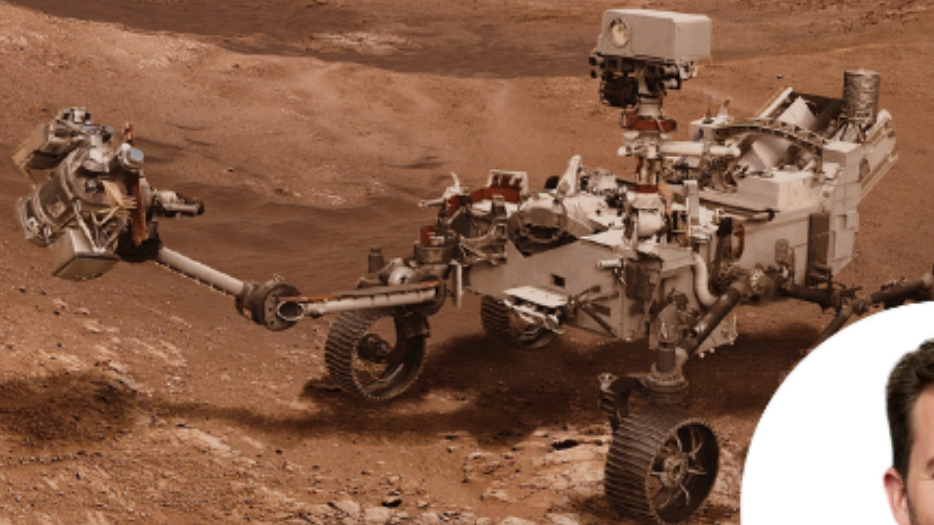


# THE SEARCH FOR LIFE ON MARS GRADE 8 & UP READING

Science  
Applicability

Sub Plan

Improve students'  
literacy skills



## Reading Comment

“

Extremely satisfied - Great resource to work on student reading comprehension and it tied into the topic I was teaching. My students have been struggling with reading and I've been incorporating more reading into my lessons. Thank you for the resource.

”

**SCROLL**  
to take a look inside!

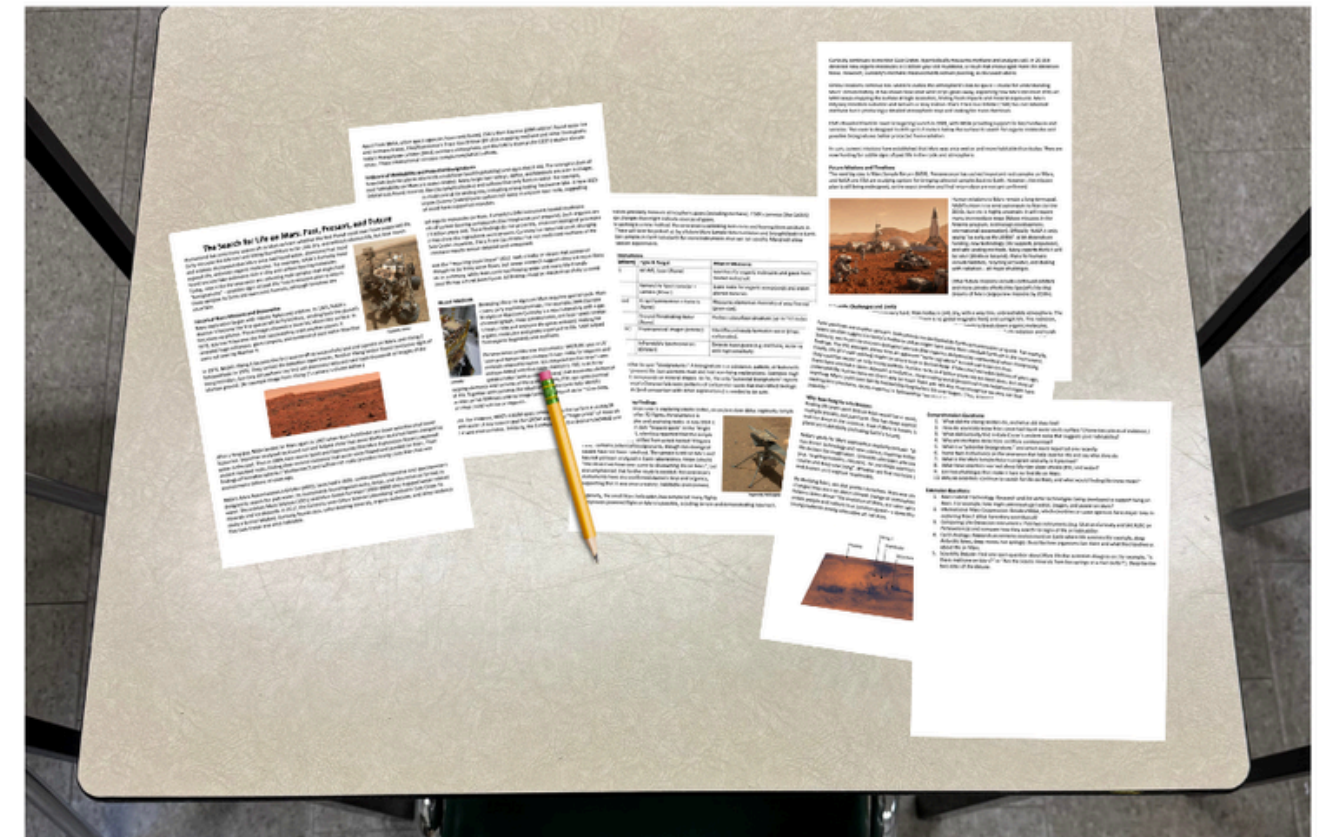


# THE PROBLEMS YOU FACE

- **Limited time to teach scientific literacy and strengthen students' reading and analysis skills.**
- **Need meaningful extension activities to engage fast-moving learners.**
- **Difficulty creating effective last-minute sub plans that still support student learning.**

## **NO-PREP - PRINT/UPLOAD**

- **CLASSROOM READY - No Prep, Ready-to-Use:** Print or assign digitally with Google Docs, Microsoft Word, and PDF formats for flexible classroom use
- **Questions and Answer Key**
- **Includes Varied Question Types:** Knowledge, thinking, connecting, application, and open-ended questions.



# What Will Your Students Learn?

## READING COMPREHENSION ARTICLE & QUESTION BUNDLE

Article with  
Comprehension  
Questions

Grade 8 and Up

Print & Digital

- Early Mars Missions
- Mariner 4 and Mariner 9
- Viking Landers and Life-Detection Experiments
- Mars Pathfinder and Sojourner
- Spirit and Opportunity Rover Discoveries
- Curiosity Rover and Gale Crater
- Evidence of Ancient Water on Mars
- Habitability and Organic Molecules
- Methane on Mars and Scientific Debate
- Perseverance Rover and Jezero Crater
- Potential Biosignatures
- Mars Rover Instruments: SAM, SHERLOC, PIXL, RIMFAX
- Mars Orbiters and Atmospheric Studies
- Mars Sample Return
- Future Human Missions to Mars
- Scientific Challenges in the Search for Life

### Comprehension Questions

1. What did the Viking landers do, and what did they find?
2. How do scientists know Mars once had liquid water on its surface? (Name two pieces of evidence.)
3. What did Curiosity find in Gale Crater's ancient rocks that suggests past habitability?
4. Why are methane detections on Mars controversial?
5. What is the "biosignature," and which rover reported one recently?
6. Name two major roles in the search for life on Mars.
7. What is the "habitability" of Mars?
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- The Search for Life on Mars: Past, Present, and Future**
- Humankind has sent many spacecraft to Mars to learn whether the Red Planet could ever have supported life. Early missions like Mariner and Viking found Mars to be cold, dry, and without obvious life, but later rovers and orbiters discovered that Mars once had liquid water, chemistry that could support life, and even organic molecules. For example, NASA's Curiosity rover found ancient lake sediments rich in clay and carbon-bearing molecules. Today, rovers like Perseverance are collecting rock samples that might hold "biosignatures" – possible signs of past life. Future missions plan to return those samples to Earth and even send humans, although timelines are uncertain.
- Historical Mars Missions and Discoveries**
- Mars exploration began with robotic flybys and orbiters. In 1965, NASA's Mariner 4 became the first spacecraft to fly by Mars, sending back the planet's first close-up photos. These images showed a cratered, Moon-like surface. In 1971, Mariner 9 became the first spacecraft to orbit another planet. It revealed huge volcanoes, giant canyons, and evidence of past water flow that were not seen by Mariner 4.
- In 1976, NASA's Viking 1 became the first spacecraft to successfully land and operate on Mars, and Viking 2 followed later in 1976. They carried life-detection experiments. Neither Viking lander found conclusive signs of living microbes, but they did perform the first soil chemistry tests and sent back thousands of images of the Martian ground. (An example image from Viking 1's camera is shown below.)
- After a long gap, NASA landed on Mars again in 1997 when Mars Pathfinder set down with the small rover Sojourner. Sojourner analyzed rocks and soil and helped show that some Martian rocks had been in water in the past. Then in 2004, twin rovers Spirit and Opportunity began the Mars Exploration Rover Mission, finding clear mineral evidence of past water. The Mars Exploration Rover Mission also mapped the surface, found more evidence of past water, and discovered strong clues about the environment.
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# Your Reading

## The Search for Life on Mars: Past, Present, and Future

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### Historical Mars Missions and Discoveries

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NASA's Mars Reconnaissance Orbiter (MRO), launched in 2005, carries powerful instruments designed to search for past water. Its instruments found layered rocks, deltas, and water. The rovers Mars Odyssey (2001) and Mars Global Surveyor (1996–2001) found minerals and ice deposits. In 2012, the Curiosity rover (Mars Science Laboratory) found a former lakebed. Curiosity found clays, sulfur-bearing minerals, organic molecules, and evidence of past water flow that were not seen by Mariner 4.



Apart from NASA, other space agencies have contributed: ESA's Mars Express (2003 orbiter) found water ice and methane traces; ESA/Roscosmos's Trace Gas Orbiter (2016) is mapping methane and other trace gases; India's Mangalyaan orbiter (2014) monitors atmosphere; and the UAE's Hope probe (2021) studies climate cycles. These international missions complement NASA's efforts.

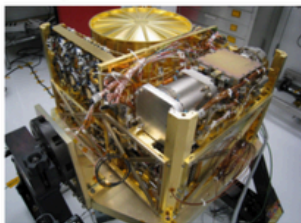
### Evidence of Habitability and Potential Biosignatures

Scientists look for places where life could have lived (habitability) and signs that it did. The strongest clues of past habitability on Mars are water-related. Many large river valleys, deltas, and lakebeds are seen in images. Orbital data found minerals like clay (phyllosilicates) and sulfates that only form in water. For example, Curiosity found ~20% clay in mudstone at its landing site, indicating a long-lasting freshwater lake. A New 2025 study of Perseverance's samples (Jezero Crater) found carbon-rich spots in ancient river rocks, suggesting chemical environments that could have supported microbes.

Scientists have also detected organic molecules on Mars. Curiosity's SAM instrument heated mudstone samples and found fragments of carbon-bearing compounds (like thiophenes and propane). Such organics are "tough" and ancient (about 3 billion years old). These findings do not prove life, since non-biological processes can create organics too, but they show the ingredients were present. Curiosity has detected small, changing amounts of methane near Gale Crater. However, ESA's Trace Gas Orbiter has not confirmed methane at the same levels globally, so the methane results remain debated and unresolved.

Another feature of interest was the "recurring slope lineae" (RSL): dark streaks on slopes that appeared seasonally. They were once thought to be briny water flows, but newer research suggests they are more likely dry sand or dust flows instead. In summary, while Mars once had flowing water and many life-friendly minerals, direct evidence of past life has not yet been found. All findings must be checked carefully to avoid false positives.

### Searching for Life: Instruments and Methods



Sample Analysis at Mars on Curiosity

Detecting life or its signs on Mars requires special tools. Mars rovers carry sophisticated labs. For example, SAM (Sample Analysis at Mars) on Curiosity is a mini laboratory with a gas chromatograph, mass spectrometer, and laser spectrometer. It heats rocks and analyzes the gases released, looking for organic molecules and gases important to life. SAM helped find organic fragments and methane.

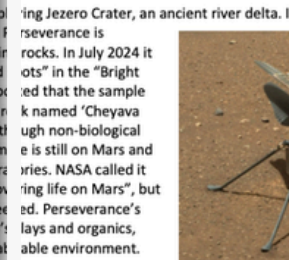
Perseverance carries new instruments: SHERLOC uses a UV laser and Raman spectroscopy to scan rocks for organics and minerals altered by water. It is mounted on the rover's arm and can detect very fine-scale chemistry. PIXL is an X-ray spectrometer (with a micro-camera) that measures elemental composition at tiny scales. By mapping elements and textures at the scale of grains, PIXL can spot chemical signatures that might hint of past life. Together with cameras like Mastcam-Z, these tools help identify "interesting" rocks. Perseverance also carries RIMFAX radar to image below the ground up to ~10 m deep, which can reveal subsurface layers that could hold ice or organics.

Orbital instruments also contribute. For instance, MRO's CRISM spectrometer scans the surface in visible/IR light to map minerals that form with water. A key science goal for CRISM was to find "fingerprints" of minerals like clays and carbonates formed in wet environments. Similarly, the ExoMars Trace Gas Orbiter's NOMAD and

ACS spectrometers precisely measure atmospheric gases (including methane). TGO's cameras (like CaSSIS) look for surface changes that might indicate sources of gases. Finally, sample caching is a new method. Perseverance is collecting rock cores and leaving them on Mars in sealed tubes. These will later be picked up by a future Mars Sample Return mission and brought back to Earth. Studying Martian samples in Earth labs (with far more instruments than we can send to Mars) will allow deeper life-detection experiments.

|                                                                                                                      | What It Measures                                           |
|----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|
| Curiosity rover                                                                                                      | Searches for organic molecules in heated rocks/soil.       |
| Perseverance rover                                                                                                   | Scans rocks for organic molecules and altered minerals.    |
| Orbiters (e.g., Mars Express, Mars Reconnaissance Orbiter, Mars Global Surveyor, Mars Odyssey, Mars Science Orbiter) | Measures elemental chemistry (grain-size).                 |
| Orbiters (e.g., Mars Express, Mars Reconnaissance Orbiter, Mars Global Surveyor, Mars Odyssey, Mars Science Orbiter) | Probes subsurface structure.                               |
| Orbiters (e.g., Mars Express, Mars Reconnaissance Orbiter, Mars Global Surveyor, Mars Odyssey, Mars Science Orbiter) | Identifies minerals (e.g., carbonates).                    |
| Orbiters (e.g., Mars Express, Mars Reconnaissance Orbiter, Mars Global Surveyor, Mars Odyssey, Mars Science Orbiter) | Detects trace gases (e.g., methane) with high sensitivity. |

Scientists are also looking for "biosignatures." A biosignature is a substance, pattern, or structure that suggests life. Scientists must also test non-living explanations. So far, the only "potential biosignature" on Mars is the "recurring slope lineae" (RSL): dark streaks on slopes that appeared seasonally. They were once thought to be briny water flows, but newer research suggests they are more likely dry sand or dust flows instead. In summary, while Mars once had flowing water and many life-friendly minerals, direct evidence of past life has not yet been found. All findings must be checked carefully to avoid false positives.



Jezero Crater, an ancient river delta. The Perseverance rover is shown in the foreground.

Curiosity continues to monitor Gale Crater. It periodically measures methane and has detected new organic molecules in 3-billion-year-old mudstone, a result that is exciting. However, Curiosity's methane measurements remain puzzling, as discussed below.

Orbital missions continue too. MAVEN studies the atmosphere's loss to space. Mars' climate history. It has shown how solar wind strips gases away, explaining Mars' climate. MRO keeps mapping the surface at high resolution, finding fresh impacts and monitoring radiation and remains a relay station. ESA's Trace Gas Orbiter is producing a detailed atmospheric map and looking for trace chemicals.

ESA's Rosalind Franklin rover is targeting launch in 2028, with NASA providing services. The rover is designed to drill up to 2 meters below the surface to search for possible biosignatures better protected from radiation.

In sum, current missions have established that Mars was once wetter and more hospitable than we once thought. Now hunting for subtle signs of past life in the rocks and atmosphere.

### Future Missions and Timelines

The next big step is Mars Sample Return (MSR). Perseverance has cached important samples, and NASA and ESA are studying options for bringing selected samples back to Earth. The plan is still being redesigned, so the exact timeline and final return date are not yet set.



Human missions to Mars are also being planned. NASA's vision is to send humans to Mars by the mid-2030s, but this is highly dependent on many intermediate steps, including the Artemis program, international cooperation, and new technologies. Funding, new technologies, and safe landing methods are all being developed. Perseverance's mission is to prepare for human exploration by caching samples and testing technologies.

Other future missions include the Mars Ice LandeR (MIL) and the Mars Polar Lander (MPL).

### Scientific Challenges and Limits

Searching for life on Mars is very hard. Mars today is cold, dry, with a very thin atmosphere. The surface is bombarded by cosmic radiation (there is no global magnetic field) and has highly reactive soil chemicals (like perchlorate salts), which tends to break down organic matter. Indeed, a NASA scientist noted: "Mars' surface is exposed to radiation from space, and the soil chemicals break down organic matter." Yet Curiosity still found ancient organic molecules, suggesting that life might have existed. In other words, organics can survive, but we must dig or drill to find them.

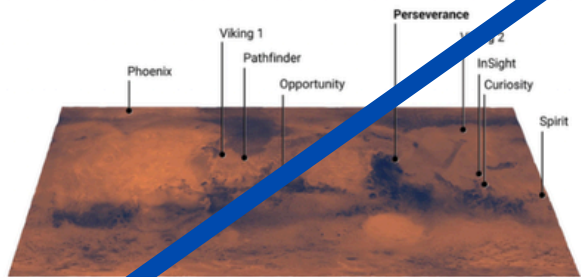
False positives are another concern. Instruments can be fooled by Earth contamination or quirks. For example, recent studies suggest Curiosity's methane spikes might have come from residual Earth air in the instrument. Similarly, we must rule out non-biological sources (like organics delivered by meteorites) when interpreting findings. The RSL example shows how an apparent "water signature" turned out to be dry dust. Finally, life (if it ever existed) might be very scarce or buried deep. If Mars had microbes billions of years ago, they could be extinct or only in tiny pockets. Surface rocks 3–4 billion years old can hold clues, but most of those have eroded or been exposed to radiation. Deep underground (protected from radiation) might have preserved life, but we have no direct way to reach there yet. We also must recognize we may not find anything; Mars could have lost its habitability long before life ever began. Thus, scientists are cautious: every exciting hint (methane, spots, organics) is followed by "we need more data" and "other explanations are possible."

### Why Searching for Life Matters

Finding life (even past life) on Mars would be a revolutionary discovery. It would show that life can arise on multiple planets, not just Earth. This has deep scientific and societal impact: it would teach us about biology and our place in the universe. Even if Mars is barren, learning why it failed to keep life helps us understand planetary habitability (including Earth's future).

NASA's goals for Mars exploration explicitly include: "determine whether life ever arose on Mars". The search has driven technology and new science, inspiring millions. On a human level, the possibility of extraterrestrial life excites the imagination. Scientists also learn practical skills (like closed-loop life support) that benefit Earth (e.g. recycling systems, robotics). As one NASA scientist said about organics: "Mars is telling us to stay the course and keep searching". Whether we find microbes or not, the effort shapes our view of life's uniqueness and pushes us to explore responsibly.

By studying Mars, we also protect ourselves. Mars was once more Earth-like, and understanding why it changed may warn us about climate change or atmospheric loss. As NASA's Mars 2020 science goals say, Mars helps us learn about "the evolution of Mars, our solar system, and life on Earth". Finally, the search for life unites people and nations in a common quest – a quest that began with ancient stargazers and continues with young students aiming telescopes at red skies.



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### Comprehension Questions

- What did the Viking landers do, and what did they find?
- How do scientists know Mars once had liquid water on its surface? (Name two pieces of evidence.)
- What did Curiosity find in Gale Crater's ancient rocks that suggests past habitability?
- Why are methane detections on Mars controversial?
- What is a "potential biosignature," and which rover reported one recently?
- Name two instruments on Perseverance that help look for life and say what they do.
- What is the Mars Sample Return program and why is it planned?
- What have scientists learned about Martian slope streaks (RSL) and water?
- List two challenges that make it hard to find life on Mars.
- Why do scientists continue to search for life on Mars, and what would finding life there mean?

### Extension Questions

- Mars Habitat Technology: Research and list some technologies being developed to support living on Mars. For example, how might astronauts get water, oxygen, and power on Mars?
- International Mars Cooperation: Besides NASA, which countries or space agencies have major roles in exploring Mars? What have they contributed?
- Comparing Life-Detection Instruments: Pick two instruments (e.g. SAM on Curiosity and SHERLOC on Perseverance) and compare how they search for signs of life or habitability.
- Analogous: Research an extreme environment on Earth where life survives (for example, deep-sea hydrothermal vents, deep mines, hot springs). Describe how organisms live there and what that teaches us about life on Mars.
- Scientific Debate: Find one open question about Mars life that scientists disagree on (for example, "Is there methane on Mars?" or "Are the Jezero minerals from hot springs or a river delta?"). Describe the two sides of the debate.

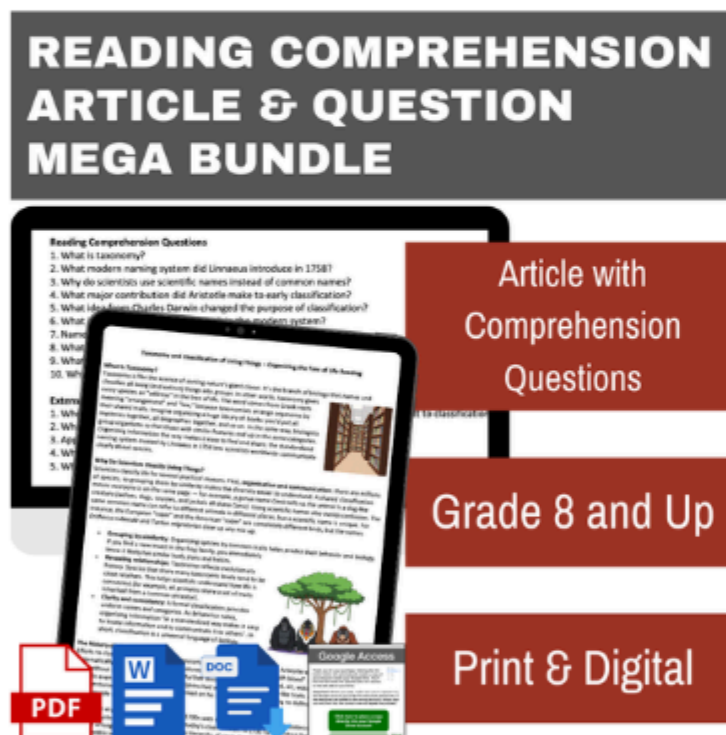
# Full Answer Key Included

# Comprehension and Extension Questions



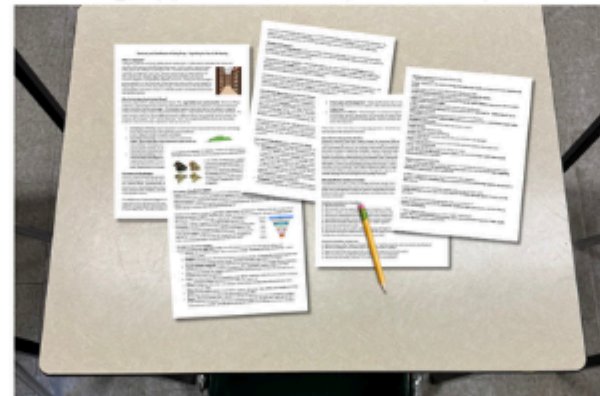
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- **Includes Varied Question Types:** Knowledge, thinking, connecting, application, and open-ended questions.



★★★★★ Extremely satisfied - It is a good supplemental activity either for review and at the same time introducing some concept. I also use this for sub plan. It is well presented, organized and interesting.

★★★★★ Extremely satisfied - This a great resource. I used this for a sub plan. It was fun and engaging for my students.

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