OSEDAX

CHEMOSYNTHETIC ECOSYSTEM SIMULATION

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Where Chemosynthesis and Photosynthesis Differ?

Chemosynthesis allows organisms to produce energy through chemical reactions, independent of sunlight. This is a fundamental difference from photosynthesis, which requires sunlight. While photosynthesis relies on sunlight, chemosynthesis occurs in dark environments like deep oceans, using chemicals as the energy source. Therefore, chemosynthesis is crucial for sustaining life in deep-sea ecosystems.

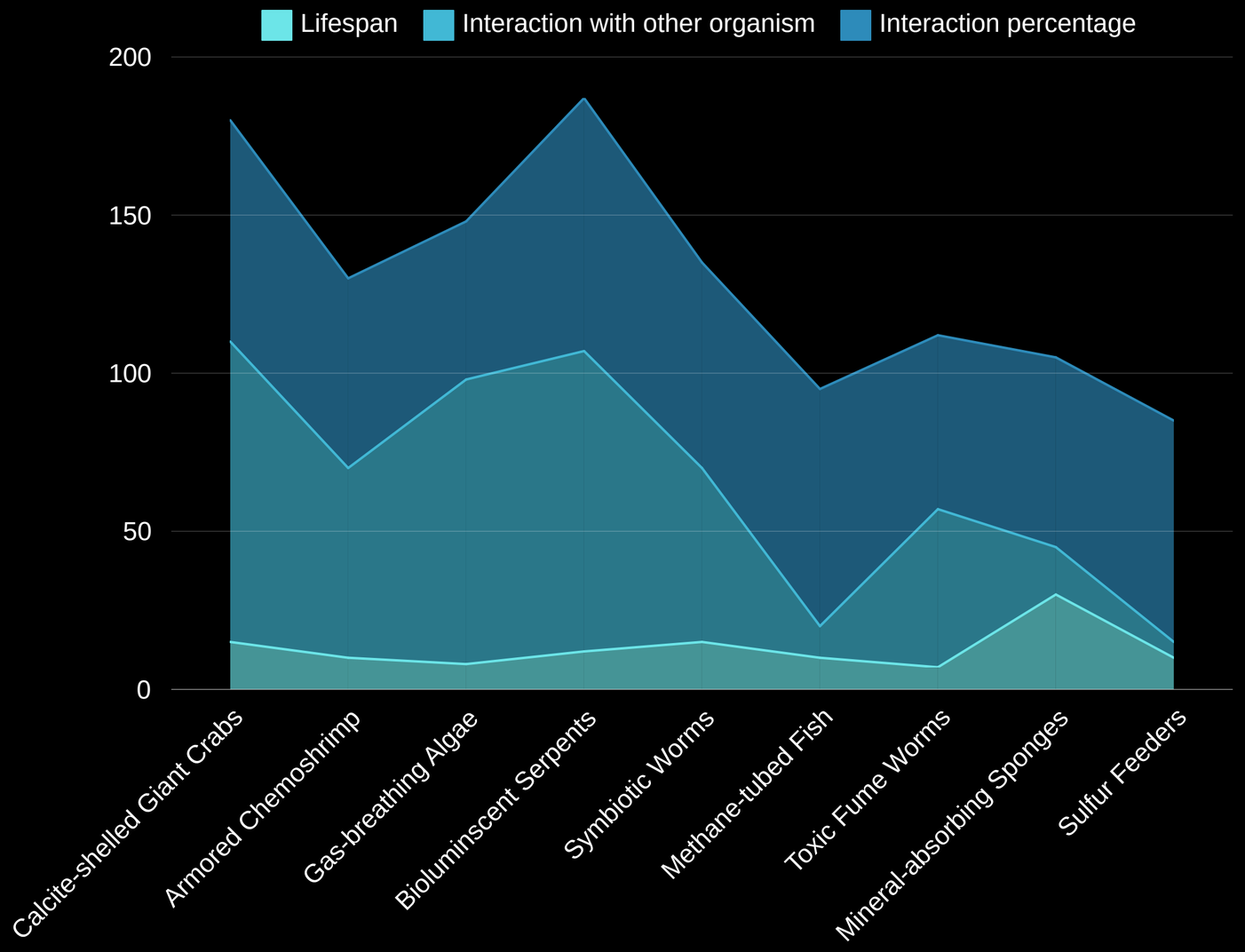
Physical Structure of the Environment

- The primary goal of our project is to create a closed and sustainable environment based on a chemosynthetic ecosystem. For this purpose, we designed the environment to mimic deep ocean conditions.

- Pressurized and darkened water tanks: By simulating deep-sea environments, we designed completely dark and high-pressure water tanks. These light-proof and pressure-resistant tanks provide an environment similar to the living conditions of deep-sea organisms.

- Hydrothermal vent simulations: Mimicking natural hydrothermal vents found in deep seas, this structure produces chemical components, serving as an energy source for chemosynthetic organisms. Systems that release chemicals such as hydrogen sulfide and methane support the ecosystem's energy cycle.

Investigating the Statistical Suitability of Living Creatures Suitable for Simulation



The organisms living in our artificial environment are designed using both natural and synthetic biology. The organisms that play a critical role in the chemosynthetic ecosystem are as follows:

- **Chemosynthetic Bacteria:** These bacteria, which produce energy by using chemical compounds like hydrogen sulfide and methane, were optimized through genetic engineering. Their chemical consumption rates and metabolic processes have been enhanced.
- **Artificial Worms:** Similar to tube worms, these artificial organisms form a symbiotic relationship with the bacteria, using the energy produced by them. These symbiotic organisms are integrated into the chemosynthesis-based energy cycle.
- **Filter Feeders:** Structures with feathery designs are created to collect chemical nutrients produced by the bacteria. These structures are micro-optimized to more efficiently filter chemicals and obtain nutrients.

Sustainable Water Management

Ecosystem Cycle and Balance Mechanisms:

To ensure the sustainability of our chemosynthetic ecosystem, chemical cycles and balance mechanisms have been established.

Chemical production and consumption balance:

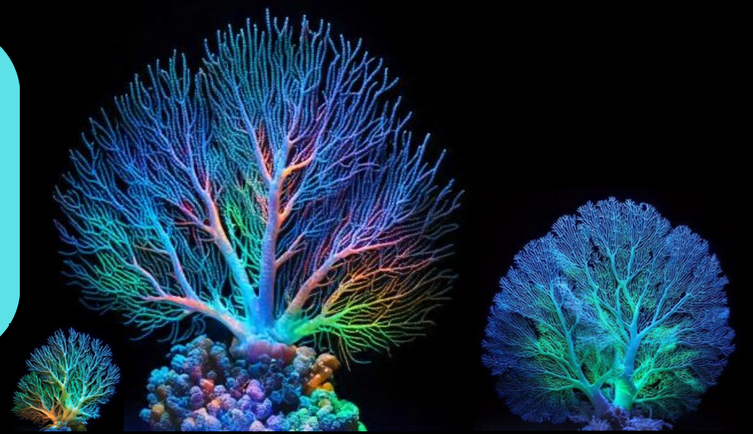
The chemicals in the environment are continuously monitored and adjusted according to consumption rates. Substances like hydrogen sulfide and methane are constantly produced and recycled within the system.

Autoregulation Systems:

In cases where the chemical balance is disrupted, automatic systems are activated. For example, if hydrogen sulfide levels decrease, this chemical is added to the environment from reserve tanks, ensuring the sustainability of the system.

Chemical Equilibrium:

Through this system, the ecosystem maintains a balanced chemical structure, allowing organisms to continue living in equilibrium.

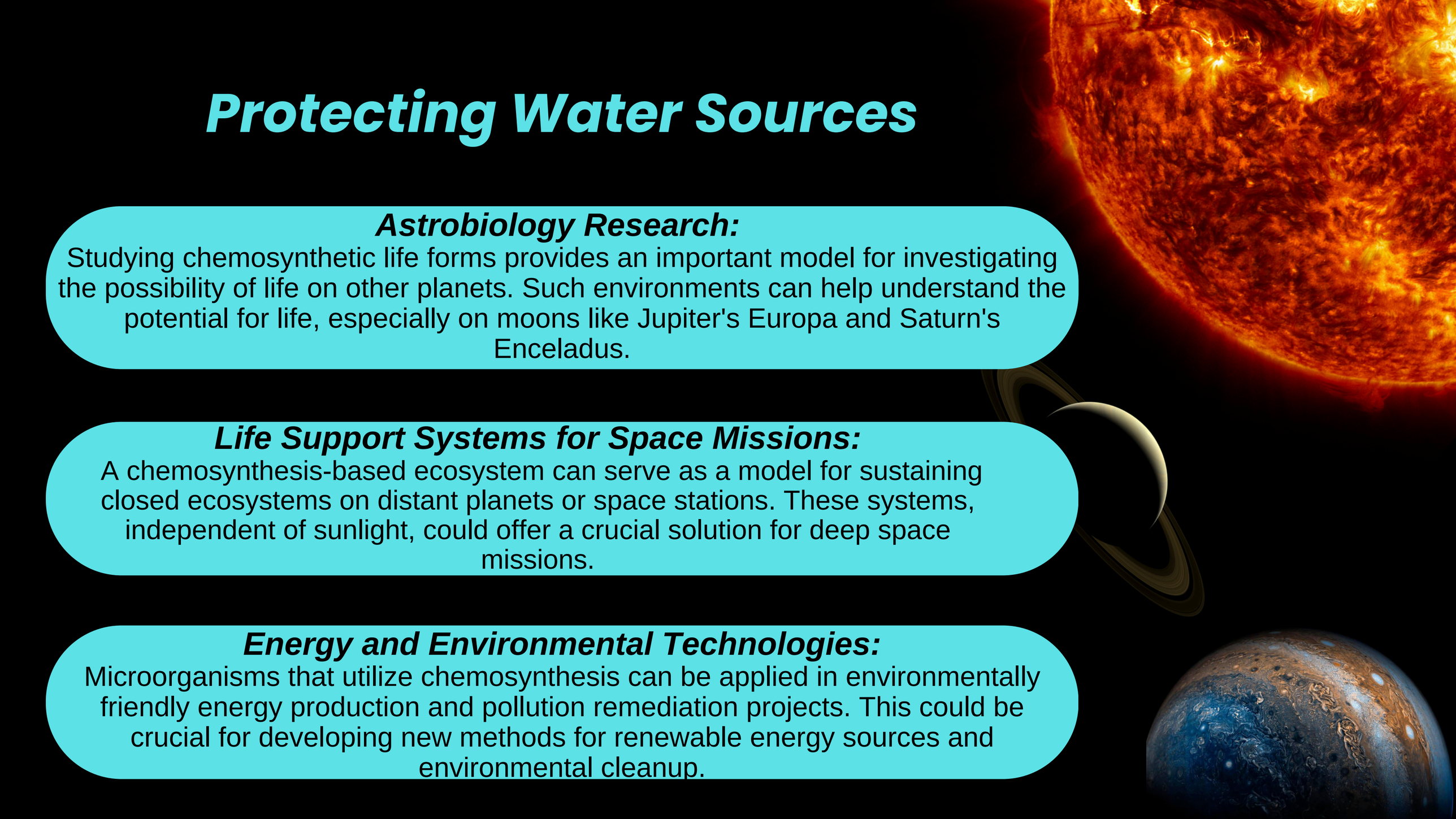


Protecting Water Sources

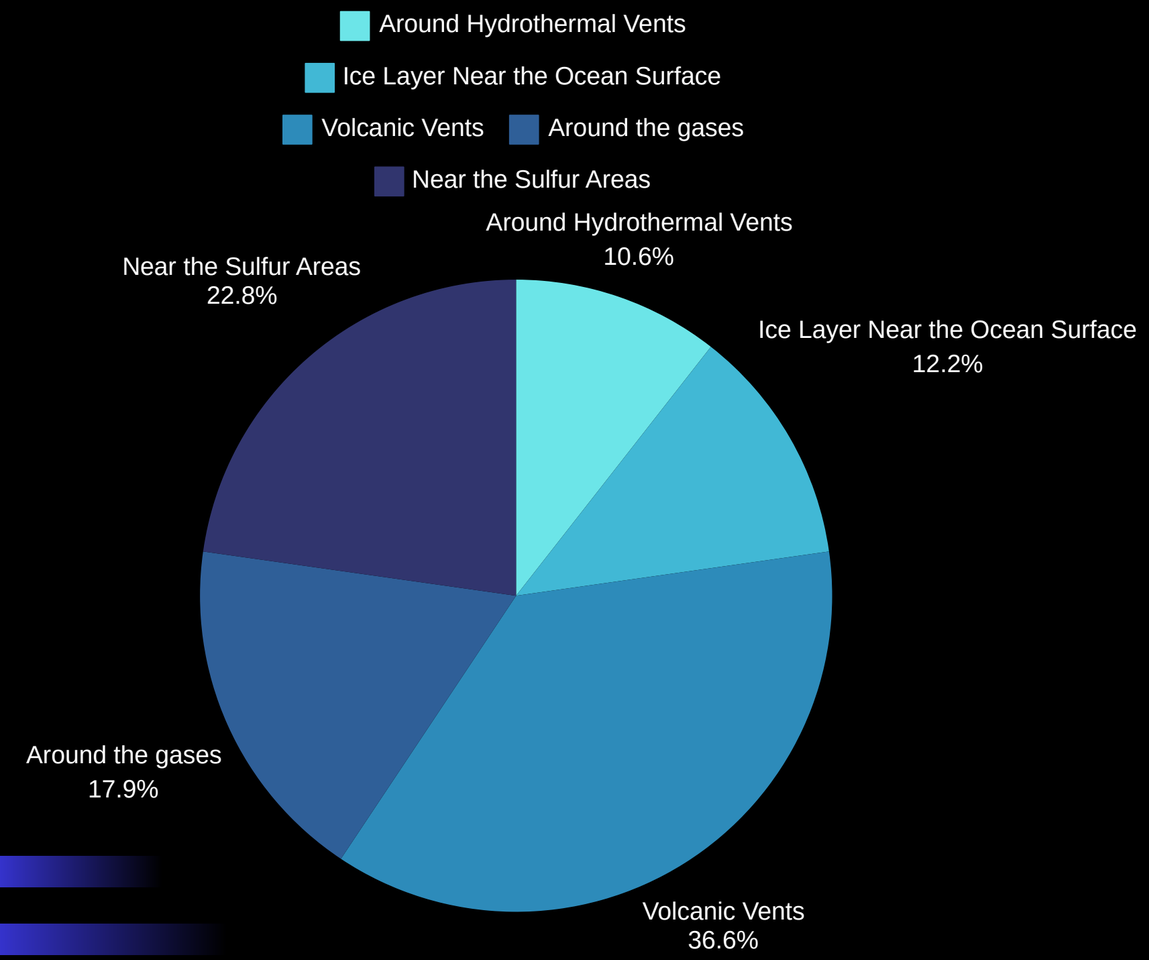
Astrobiology Research:
Studying chemosynthetic life forms provides an important model for investigating the possibility of life on other planets. Such environments can help understand the potential for life, especially on moons like Jupiter's Europa and Saturn's Enceladus.

Life Support Systems for Space Missions:
A chemosynthesis-based ecosystem can serve as a model for sustaining closed ecosystems on distant planets or space stations. These systems, independent of sunlight, could offer a crucial solution for deep space missions.

Energy and Environmental Technologies:
Microorganisms that utilize chemosynthesis can be applied in environmentally friendly energy production and pollution remediation projects. This could be crucial for developing new methods for renewable energy sources and environmental cleanup.



Number of Organisms In the Simulation



Chemosynthetic Organisms and Ecosystem Dynamics:

This graphic illustrates the types of chemosynthetic organisms present in the simulation system and their interactions with each other. Chemosynthetic organisms produce energy from chemical compounds, forming the foundation of the food chain. For example, organisms living around hydrothermal vents utilize substances like sulfur or methane to obtain energy. Through their symbiotic relationships with other organisms, these organisms create a rich ecosystem dynamic. The graphic emphasizes the diversity of these interactions and the significance of chemosynthesis in ecosystems.