

DEEP SEA MINING

GRADE 8 & UP READING

Sub Plan

Science
Applicability

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.

”

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to take a look inside!

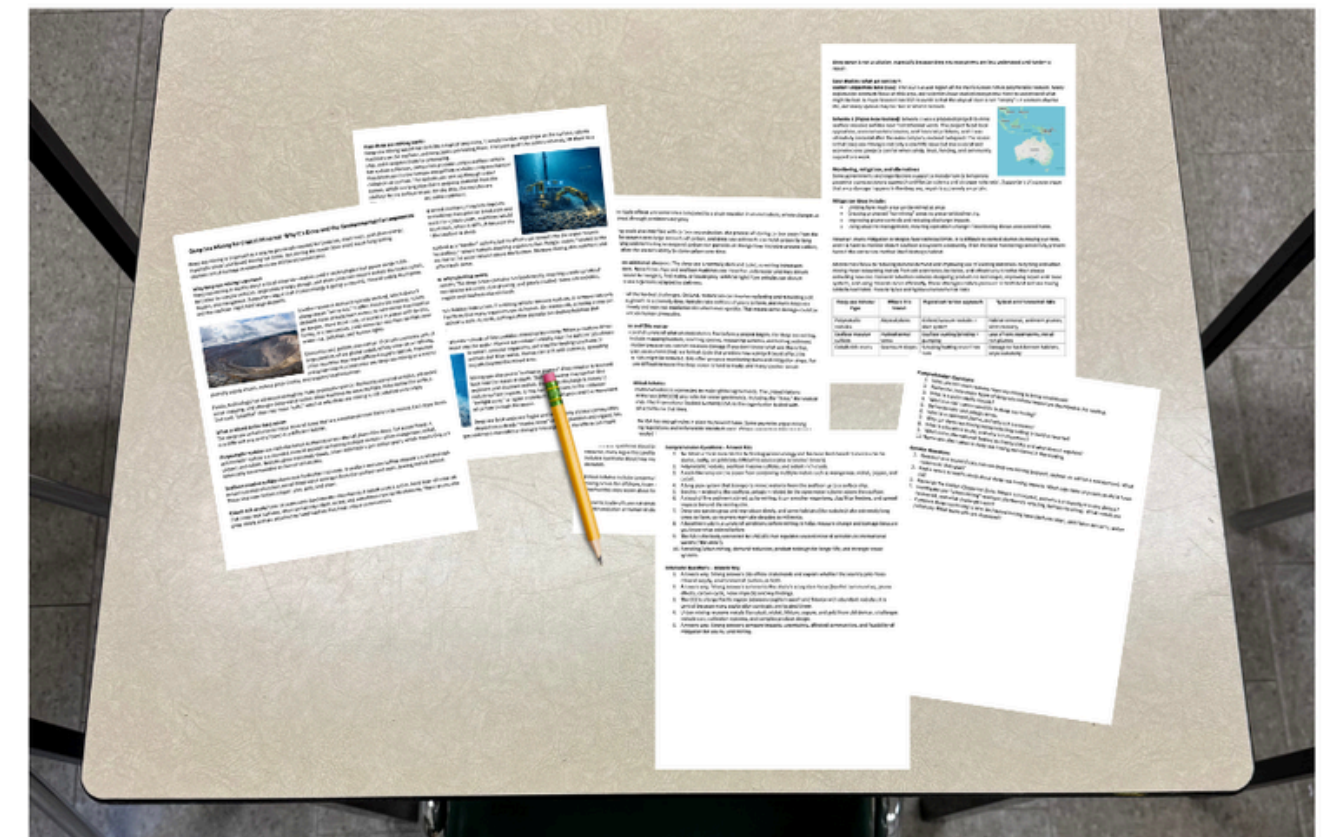


THE PROBLEMS YOU FACE

- 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

- Deep sea mining and critical minerals
- Why deep sea mining is being considered
- Polymetallic nodules, seafloor massive sulfides, and cobalt-rich crusts
- How deep sea mining works
- Benthic and pelagic zones
- Sediment plumes and habitat destruction
- Biodiversity, endemic species, and slow ecosystem recovery
- Carbon sequestration and deep-sea ecosystem impacts
- Baseline studies and environmental impact assessments
- UNCLOS, the ISA, and ocean governance
- The Clarion-Clipperton Zone and Solwara 1
- Mitigation, moratoriums, recycling, and urban mining alternatives

Comprehension Questions

1. What are two main reasons deep sea mining is being considered?
2. Name the three major types of deep-sea mineral resources described in the reading.
3. What is a polymetallic nodule?
4. What is a riser system used for in deep sea mining?
5. Define benthic and pelagic zones.
6. Why is deep sea mining being considered?
7. What are the environmental consequences of deep sea mining?
8. What are the economic benefits of deep sea mining?
9. What are the social impacts of deep sea mining?
10. What are the political challenges of deep sea mining?

Extension Questions

1. Why deep sea mining is pursued
Deep sea mining is mostly about critical minerals—metals used in technologies that power modern life. Batteries for electric vehicles, large-scale energy storage, and electronics can require metals like nickel, cobalt, copper, and manganese. Supporters argue that if clean energy is going to expand, mineral supply must grow, and the seafloor might hold large deposits.
2. Another reason is resource scarcity on land, which doesn't always mean "we're out." It often means the easiest, richest deposits have already been mined, so new mines may need to go deeper, move more rock, or operate in places with forests, farms, or communities. Land mines can also face conflicts over water use, pollution, and human rights.
3. Economics and politics also matter. If certain countries control large portions of the global supply of key minerals or refining, other countries may want different supply options. Investors and governments sometimes see deep sea mining as a way to diversify supply chains, reduce price shocks, and support local industries.
4. Finally, technology has advanced enough to make proposals realistic. Remotely operated vehicles, advanced sonar mapping, and stronger deep-water cables allow machines to work multiple miles below the surface. That said, "possible" does not mean "safe," which is why deep sea mining is still debated so strongly.
5. What is mined in the deep ocean
The deep sea contains three major mineral types that are considered most likely to be mined. Each type forms in a different way and is found in a different habitat.
6. Polymetallic nodules are rock-like lumps scattered across abyssal plains (the deep, flat ocean floor). A polymetallic nodule is a rounded mineral deposit containing multiple metals—often manganese, nickel, copper, and cobalt. Nodules grow extremely slowly, often millimeters per million years, and are essentially nonrenewable on human timescales.
7. Seafloor massive sulfides (SMS) are mineral deposits that form on the seafloor. They are composed of iron, copper, zinc, and silver. SMS are found in hydrothermal vents, also known as "black smokers." They are formed by the precipitation of minerals from superheated hydrothermal fluids.
8. Cobalt-rich crusts are mineral deposits that form on the seafloor. They are composed of cobalt, nickel, and copper. They are found in hydrothermal vents, also known as "black smokers." They are formed by the precipitation of minerals from superheated hydrothermal fluids.

Google Access



Your Reading

Deep Sea Mining for Critical Minerals: Why It's Done and the Environmental Consequences

Deep sea mining is proposed as a way to get metals needed for batteries, electronics, and clean energy, especially when land-based mining has limits. But mining the ocean floor could cause long-lasting environmental damage in ecosystems we still barely understand.

Why deep sea mining is pursued

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What is mined in the deep ocean

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Polymetallic nodules are rock-like lumps scattered across abyssal plains (the deep, flat ocean floor). A polymetallic nodule is a rounded mineral deposit containing multiple metals—often manganese, nickel, copper, and cobalt. Nodules grow extremely slowly, often millimeters per million years, which means they are essentially nonrenewable on human timescales.

Seafloor massive sulfides form near hydrothermal vents. A seafloor massive sulfide deposit is a mineral-rich mound created when hot, metal-filled water emerges from the seafloor and cools, leaving metals behind. These sites can contain copper, zinc, gold, and silver.

Cobalt-rich crusts form on seamounts (underwater mountains). A cobalt crust is a thin, hard layer of minerals that coats rock surfaces, often containing cobalt, nickel, and sometimes rare earth elements. These crusts also grow slowly and are attached to hard habitats that host unique communities.

How deep sea mining works

Deep sea mining would not look like a typical land mine. It would involve large ships on the surface, robotic machines on the seafloor, and long pipes connecting them. The basic goal is to collect minerals, lift them to a ship, and transport them for processing.

For nodule collection, companies propose using a seafloor vehicle that drives across the bottom and gathers nodules using mechanical collectors or suction. The nodules are sent up through a riser system, which is a long pipe that transports material from the seafloor to the surface vessel. On the ship, the nodules are separated from seawater and some sediment.



For massive sulfides, mining would involve cutting into deposits using heavy equipment. The machines may grind or break rock and pump crushed material upward. For cobalt crusts, machines would scrape or cut crust off seamount rock, which is difficult because the crust is attached tightly and the seafloor is steep.

Deep sea mining is often described as a "benthic" activity, but its effects can spread into the water column. Benthic means "related to the seafloor," where bottom-dwelling organisms live. Pelagic means "related to the open water," where organisms live in the water column above the bottom. Because mining stirs sediment and releases waste water, it can affect both zones.

Environmental consequences: why scientists worry

Deep sea ecosystems are not empty. The deep ocean contains rich biodiversity, meaning a wide variety of living organisms. Many deep-sea species are small, slow-growing, and poorly studied. Some are endemic, meaning they live only in one region and nowhere else on Earth.

One of the most direct impacts is habitat destruction. If a mining vehicle removes nodules, it removes not only the minerals but also the hard surfaces that many organisms use as homes. On seamounts, scraping crusts can remove living communities attached to rock. At vents, cutting sulfide deposits can destroy habitats that support highly specialized life.

Another major risk is sediment plumes—clouds of fine particles stirred up by mining. When a machine drives or cuts the seafloor, it lifts sediment into the water. Plumes can reduce turbidity near the bottom (cloudiness in water), smother organisms, and clog the feeding structures of animals that filter water. Plumes can drift with currents, spreading impacts beyond the mined area.



Mining can also create "midwater plumes" if wastewater is released back into the ocean at depth. That wastewater may contain fine sediment and dissolved metals. Even if the discharge is meant to reduce surface impacts, it may harm organisms in the midwater "twilight zone," a region important for food webs and the movement of carbon through the ocean.

Deep sea food webs are fragile and slow. Many abyssal communities depend on a steady "marine snow" of dying plankton and organic bits falling from above. If mining changes sediment chemistry or disrupts tiny organisms, the effects can ripple

upward. These ripple effects are sometimes compared to a chain reaction in an ecosystem, where changes at the bottom spread through predators and prey.

Deep sea mining could also interfere with carbon sequestration, the process of storing carbon away from the atmosphere. The ocean stores large amounts of carbon, and deep-sea sediments can hold carbon for long periods. Disturbing sediments may re-suspend carbon-rich particles or change how microbes process carbon, which could weaken the ocean's ability to store carbon over time.

Noise and light are additional stressors. The deep sea is normally dark and quiet, so mining introduces natural conditions. Noise from ships and seafloor machines can travel far underwater and may disturb animals that use sound to navigate, find mates, or locate prey. Artificial light from vehicles can disrupt behaviors of deep-sea organisms adapted to darkness.

Restoration is one of the hardest challenges. On land, restoration can involve replanting and rebuilding soil, but in the deep sea, growth is extremely slow. Nodules take millions of years to form, and many deep-sea species reproduce slowly and may not recolonize disturbed areas quickly. That means some damage could be effectively permanent on human timescales.

Why baseline studies and EIAs matter

A baseline study is a careful survey of what an ecosystem is like before a project begins. For deep sea mining, baseline studies can include mapping habitats, counting species, measuring currents, and testing sediment chemistry. Baselines matter because you cannot measure damage if you don't know what was there first. An environmental impact assessment (EIA) is a formal study that predicts how a project could affect the environment, and how risks might be reduced. EIAs often propose monitoring plans and mitigation steps. For deep sea mining, EIAs are difficult because the deep ocean is hard to study, and many species remain unknown.

Legal, economic, and ethical debates

Deep sea mining in international waters is connected to major global agreements. The United Nations Convention on the Law of the Sea (UNCLOS) sets rules for ocean governance, including the "Area," the seabed beyond national boundaries. The International Seabed Authority (ISA) is the organization tasked with regulating mineral-related activities in that Area.

A key debate is whether the ISA has enough rules in place to prevent harm. Some countries argue mining should not start until strong regulations and enforceable standards exist. Others argue that delaying mining slows access to minerals needed for energy transitions and economic development.

There are also questions about benefit-sharing. Because the Area is often described as a shared global resource, many argue that profits should benefit humanity broadly, not only companies or a few nations. This includes questions about how money is shared, how environmental harm is handled, and who has a voice in decisions.

Legal debates include concerns from Indigenous and coastal communities, especially in the Pacific. Even if mining occurs far offshore, it can affect fishing industries, cultural ties to the ocean, and regional economies. Communities may worry about food security, ocean health, and whether they truly consent to risks.

Economic trade-offs are not simple. Supporters argue deep sea mining could reduce some land-based impacts like deforestation or human displacement from terrestrial mines. Opponents argue that shifting damage to the

deep ocean is not a solution, especially because deep sea ecosystems are less understood and harder to repair.

Case studies: what we can learn

Clarion-Clipperton Zone (CCZ): The CCZ is a vast region of the Pacific Ocean rich in polymetallic nodules. Exploration contracts focus on this area, and scientists have studied ecosystems there to understand what might be lost. A major lesson from CCZ research is that the abyssal plain is not "empty"—it contains life, and many species may be rare or slow to recover.



Solwara 1 (Papua New Guinea): Solwara 1 was a proposed project to mine seafloor massive sulfides near hydrothermal vents. The project faced local opposition, environmental concerns, and financial problems, and it was ultimately canceled after the main company involved collapsed. The lesson is that deep sea mining is not only a scientific issue but also a social and economic one: projects can fail when safety, trust, funding, and community support are weak.

Monitoring, mitigation, and alternatives

Some governments and organizations support a moratorium (a temporary pause) or a precautionary approach until better science and stronger rules exist. Supporters of that approach argue that once damage happens in the deep sea, repair is extremely uncertain.

Mitigation ideas include:

- Limiting how much area can be mined at once
- Creating protected "no-mining" zones to preserve biodiversity.
- Improving plume controls and reducing discharge impacts.
- Using adaptive management, meaning operations change if monitoring shows unexpected impacts.

However, many mitigation strategies face technical limits. It is difficult to control plumes in moving water, and it is hard to monitor distant seafloor ecosystems constantly. Even the best monitoring cannot guarantee no harm if the extraction method itself destroys habitat.

Alternatives focus on reducing mineral demand and improving use of existing materials. Deep-sea mining mean recovering metals from old electronics, batteries, and infrastructure rather than extracting new ore. Demand reduction includes designing products to last longer, improving systems for recycling, and using minerals more efficiently. These strategies reduce pressure on both land and sea. **Edited text table: mineral types and typical environmental risks**

Deep-sea mineral type	Where it is found	Typical extraction approach	Typical environmental risk
Polymetallic nodules	Abyssal plains	Collect/vacuum nodules + riser system	Habitat removal, slow recovery
Seafloor massive sulfides	Hydrothermal vents	Seafloor cutting/grinding + pumping	Loss of vent enrichment plumes
Cobalt-rich crusts	Seamount slopes	Scraping/cutting crust from rock	Damage to hard slope instability

Comprehension Questions

- What are two main reasons deep sea mining is being considered?
- Name the three major types of deep-sea mineral resources described in the reading.
- What is a polymetallic nodule?
- What is a riser system used for in deep sea mining?
- Define benthic and pelagic zones.
- What is a sediment plume, and why is it a concern?
- Why can deep sea mining impacts be long-lasting or hard to reverse?
- What is a baseline study, and why is it important?
- What is the International Seabed Authority (ISA), and what does it regulate?
- Name one alternative to deep sea mining mentioned in the reading.

Extension Questions

- Research one country's position on deep sea mining (support, oppose, or call for a moratorium). What reasons do they give? Find a recent scientific study about deep sea mining impacts. What organisms or processes did it focus on?
- Research the Clarion-Clipperton Zone. Where is it located, and why is it important in this debate? Investigate one "urban mining" example (electronics recycling, battery recycling). What metals are recovered, and what challenges exist?
- Compare deep sea mining to one land-based mining issue (deforestation, child labor concerns, water pollution). What trade-offs are discussed?

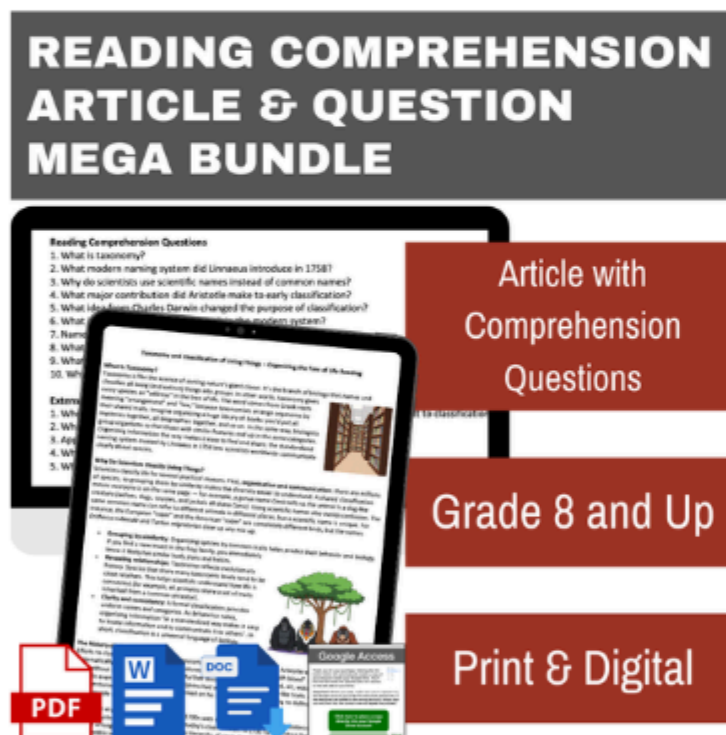
Full Answer Key Included

Comprehension and Extension Questions



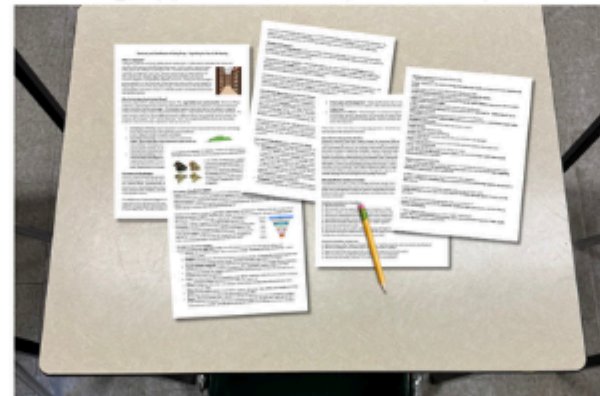
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★★★★★ Extremely satisfied - It is a good supplemental activity either for review and at the same time introducing some concept. I also use this for sub plan. It is well presented, organized and interesting.

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

Grade 8 and Up Scientific Reading Comprehension Article Mega Bundle

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