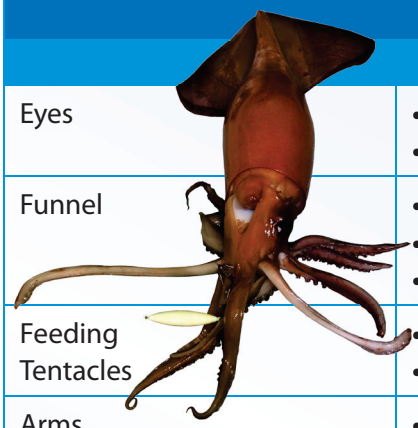
Source Materials for Step 2

AS YOU READ You will be writing an informative essay about deep-sea creatures. Carefully study the sources in Step 2. Annotate by underlining and circling information that may be useful to you when you write your essay.

Source 1: Database



Giant Squid (*Architeuthis dux*)	
Anatomy	
Eyes	• Two eyes, each with a diameter of about 30 centimeters • Largest eyes of any animal on earth—great light-absorbing capacity
Funnel	• Located beneath the squid's body, or mantle • Pumps water, creating jet propulsion • Also serves to squirt ink, lay eggs, and expel waste
Feeding Tentacles	• Two tentacles, each up to 10 meters long • Tipped with hundreds of powerful, toothed suckers
Arms	• Eight arms, each about half the length of the feeding tentacles • Lined with thousands of powerful, toothed suckers • Guide squid's prey from its tentacles to its beak
Beak	• Located at the base of the feeding tentacles and arms • Slices prey into pieces for eating
Coloration	• At ocean surface: reddish orange to pink, with white mottling • In deep water: silvery to gold, depending on light source and angle
Ecology	
Range	• Worldwide • Rarely swims in polar or tropical seas—from distribution of specimens washed ashore
Habitat	• Probably prefers continental shelves and island slopes • 500 to 1,000 meters below ocean surface
Life Span	• Less than five years—as evidenced by growth rings in statoliths (mineralized organs that help the squid balance)
Reproduction	• Each individual probably mates only once
Diet	• Fish and other squids—from stomach contents of specimens washed ashore
Predators	• Sperm whales

Discuss and Decide

In what ways is the giant squid adapted for ocean living? Cite text evidence.

Source 2: Science Article

Zombie Worms Drill Whale Bones with **Acid**

by Martha Ennis, Zoological Manager

Monterey, California—A mystery of one of the deep ocean's strangest creatures, the "zombie worms" of the *Osedax* family, has been solved. Analyzing the worms' tissues, scientists have discovered enzymes that secrete acid. This acid is crucial to the worms' remarkable life history.

In 2002, scientists at the Monterey Bay Aquarium Research Institute accidentally discovered these small worms at the bottom of the sea off the coast of California. The worms live on the skeletons of whales, which drift down to the ocean floor and constitute a rich source of nutrients. Somehow the worms drill into the bones and extract the stored nutrients, but scientists were puzzled because the worms have no body parts for physically drilling into the hard material. Indeed, the worms lack even a mouth and gut.

Instead, it turns out, the worms have developed a chemical strategy. A zombie worm attaches to a whale bone with special root-like structures. The skin cells of these structures produce an acid, which dissolves the bone, allowing the worm to extract the nutrients.

This is just one of *Osedax* worms' unusual adaptations for life on the ocean floor. In a classic example of symbiosis, the worms depend on internal bacteria to digest the fats and oils extracted from their whale-bone diet. And only female "zombies" grow to adulthood. Males, which live out their lives in the gelatinous tubes inside each female, never develop past larvae.

Close Read

In what ways have zombie worms adapted to their environment? Cite evidence from the text.

Source 3: Field Notes

Trip into Blackness

by Arthur Jonssen, Marine Biologist
Mariana Trench, Pacific Ocean

11:20 A.M. The weather is good, and the sea is calm, so our dive can proceed. After climbing into the submersible, we test the motors, batteries, robotic arms, and CO_2 scrubber. We review safety and emergency procedures with the ship's crew. Finally, the hatch is cranked shut, and we are ready to go.

11:52 A.M. The submersible vibrates and tilts. I hear the squeal of the winch as we are lifted from the ship's deck and lowered into the ocean.

12:04 P.M. As we descend, leaving the world of sunlight behind, the ocean shifts from green to aquamarine to an intense glowing blue, like the sky just after sunset. At a depth of about 500 meters, the panorama outside our bubble darkens and our visibility reduces rapidly.

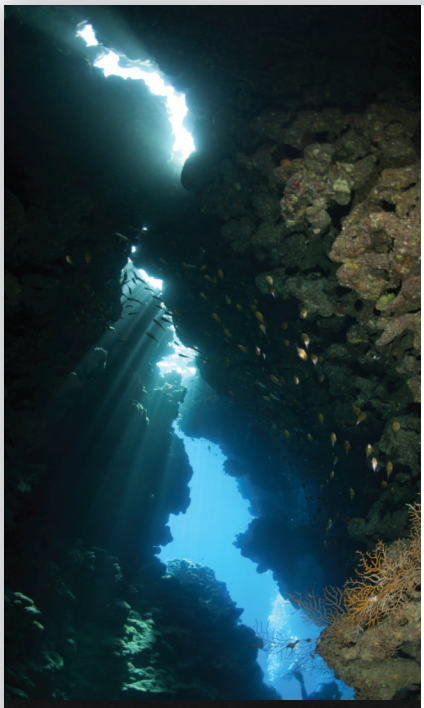
12:15 P.M. We're nearing the ocean floor at a depth of about 820 meters. The view outside is inky black. We keep the submersible's powerful lights off, for they might scare away our quarry. There! And there! We begin to see flashes of light—blue, yellow, red, and orange—as bioluminescent fish swim to avoid us.

12:48 P.M. A large jellyfish swims by, flashing bright blue lights in a circular pattern that also turns on and off. Here is a good example of a bioluminescent "burglar alarm." If threatened by a predator, the jellyfish's striking display might scare the predator away. Or it might attract an even bigger predator that could then eat the fish that was about to eat the jellyfish.

Close Read

Why does the jellyfish use bioluminescence as a defense, instead of remaining unseen in the darkness?

Source 4: Informational Article



DEEP-SEA VENTS

by Amy Bliss

Location Near Antarctica in the Southern Pacific, 7,200 feet below the surface lies a chain of hydrothermal vents. This area has only recently been explored by a team of scientists. Because scientists are not adapted for deep-sea life, they used a remote-controlled underwater vehicle to explore the landscape.

Climate It's very hot and very cold at the same time. Hydrothermal vents form where two continental plates collide. Cold seawater pours into the earth's crust and encounters molten rocks. Water spewing back out of the vents' chimneys might reach 700°F. A few feet away, water is barely above freezing.

This unusual geology creates an extraordinary biological opportunity. When frigid water meets hot rock, chemical reactions produce an array of mineral compounds, which many organisms consider food. Down here, the web of life depends on chemistry, not photosynthesis.

Yeti Crabs Gathered in heaps around the thermal vents, white crabs wave their claws together in unison. Dubbed "yeti crabs" for their hairy chests and legs, these creatures are new to science. And they are clearly thriving, with up to 600 "yetis" living on each square meter (about 11 square feet) of their favored real estate. What do they eat? Scientists aren't sure but conjecture that mineral-eating bacteria might grow on the crabs' hairs and that the crabs might scoop up the bacteria.

Discuss and Decide

How does the yeti crabs' diet work as an adaptation for their environment?

ASSIGNMENT

Write an informative essay to answer this question: What adaptations allow deep-sea creatures to survive in extreme environments?

Planning and Prewriting

Before you start writing, review your sources and start to synthesize, or integrate, the information they provide. Collect textual evidence in the chart below.


You may prefer to do your planning on the computer.

Decide on Key Points

Summarize the main points and supporting evidence to include in your essay.

Characteristics	Zombie Worms	Giant Squid	Yeti Crabs
1. Habitat ☐ Alike ☑ Different	The ocean floor	Continental shelves and island slopes	Southern ocean in hydrothermal vents
2. Appearance ☐ Alike ☐ Different			
3. Diet ☐ Alike ☐ Different			
4. Predators ☐ Alike ☐ Different			
5. Age ☐ Alike ☐ Different			
6. Reproduction ☐ Alike ☐ Different			

Developing Your Topic

Before you write your essay, decide how to arrange your ideas. You can use one of the patterns of organizing described below or come up with you own arrangement—whatever works best for your subject and evidence. Begin your essay with an introductory paragraph and end with a concluding paragraph.

Point-by-Point Discuss the first point of comparison or contrast for both giant squids and yeti crabs, then move on to the second point. If you choose this organization, you will read across the rows of this chart.

Characteristic	Zombie Worms	Giant Squid	Yeti Crab
1. Habitat			
2. Appearance			
3. Diet			
4. Predators			
5. Age			
6. Reproduction			

If you use this organizational structure, your essay will have a paragraph comparing or contrasting the habitats of giant squids yeti crabs, and zombie worms, followed by paragraphs comparing and contrasting the other points in your chart. Your evidence should include details that show how each creature adapts to its environment.

Subject-by-Subject Discuss all the points about giant squids before moving on to yeti crabs. If you choose this method, you will be reading across the rows of this chart.

Topic	Habitat	Appearance	Diet	Predators	Age	Reproduction
1. Zombie Worms						
2. Giant Squid						
3. Yeti Crab						

If you use this organizational structure, your essay will start with one or two paragraphs about zombie worms, followed by one or two paragraphs containing points you choose to write about the giant squid.

As you write, look back at the selections for examples of descriptive details that you can use in your essay.