



The photographs below show the same coral reef before and after exposure to extremely warm ocean water temperatures.

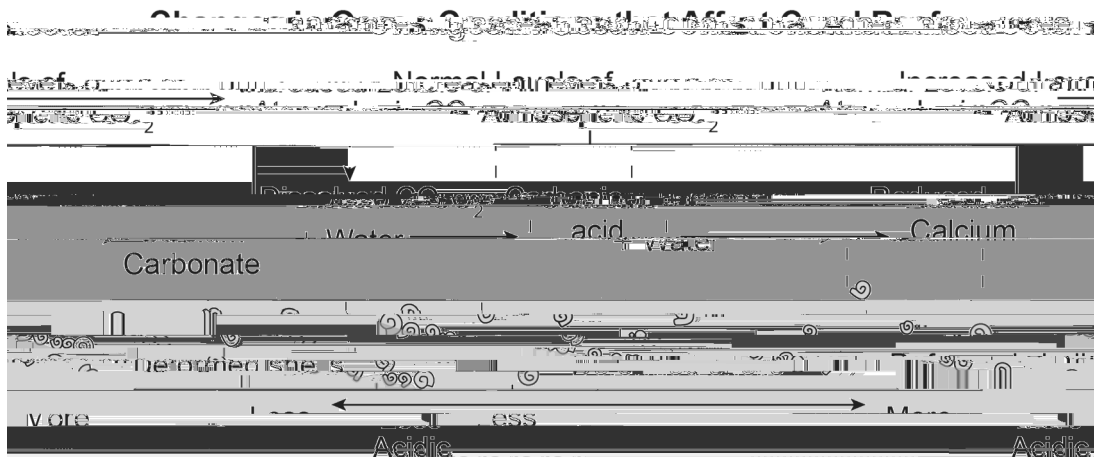
- 1 Which claim best describes the interactions in the coral reef ecosystem since the 1980s and the effect on the biodiversity in those regions?
  - (1) The coral reef ecosystem was stable, so

Coral reefs form over many thousands of years as tiny animals called polyps produce a calcium carbonate ( $\text{CaCO}_3$ ) skeleton.



One potential source of stress on coral reefs is atmospheric carbon dioxide, which dissolves in the seawater forming carbonic acid. When excess carbon dioxide is present, it changes the acidity of ocean water and the availability of calcium carbonate for organisms to build and maintain their shells, skeletons, and other calcium carbonate-based structures.

Research shows that another stressor is the current trend of the large-scale temperature change in oceans. This causes the zooxanthellae to either leave or be ejected from the coral polyps. The graphs below show changes in ocean conditions over the past century.



- 3 Which claim best explains how continued changes in ocean acidity would affect the stability of the coral reef ecosystem?
- (1) Decreasing dissolved carbon dioxide will decrease the acidity of oceans and cause ocean water to warm.
  - (2) As the acidity of the oceans increases, the coral polyps will not have enough calcium carbonate to form their skeletons.
  - (3) Ocean acidification will reverse the effects of ocean warming and contribute to stabilizing the coral reef ecosystem.
  - (4) The coral polyps will need to adapt to the decreasing acidity and find a different substance to form their skeleton.
- 4 Use evidence from the information provide







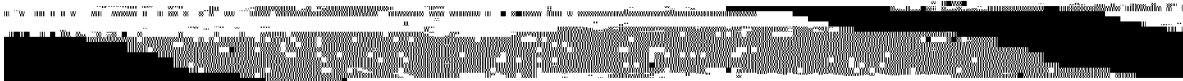
6 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

- **Benefit:** More coral will survive to build up the reef.  
**Drawback:** If the temperatures continue to rise, even the heat-tolerant ones may not survive.
- **Benefit:** The selectively bred corals will restore the reefs, so tourism may increase in these areas.  
**Drawback:** One of the heat-tolerant corals from another reef may become an invasive species on the repaired reef.
- **Benefit:** The heat-tolerant corals and zooxanthellae will increase the biodiversity of the reefs.  
**Drawback:** The transplanted corals could disrupt existing food webs.
- **Benefit:** The selectively bred corals can restore some polyps.  
**Drawback:** Coral grows so slowly it may take too many years to repair the damage caused by stressing factors.

Base your answers to questions 1 through 5 on the information below and on your knowledge of biology.

### Dinosaurs: Some Live and Some Die

Avian (bird-like) and non-avian dinosaurs in the northern hemisphere lived in extreme heat. The average summer temperature could range from 81° to 104°F. Winters were mild and wet, averaging around 59°F. There was no polar ice at this time. Most non-avian dinosaurs had a mass of about 7700 pounds. Most avian dinosaurs weighed significantly less and most mammals that coexisted with the dinosaurs weighed less than a pound.



A giant asteroid struck just off the coast of Mexico 66 million years ago. The asteroid impact event is referred to as the K-T extinction. Enormous amounts of dust, sulfur, and carbon dioxide entered the atmosphere. It caused Earth's average surface air temperatures to drop by as much as 47° F. Dust from the impact blocked the Sun's radiation for an extended amount of time, and photosynthesis was drastically reduced.

Many dinosaurs were immediately killed while others managed to survive for a period of time. All of the non-avian dinosaurs went extinct. The mammals that survived the impact increased in number. They continued to survive and evolve.

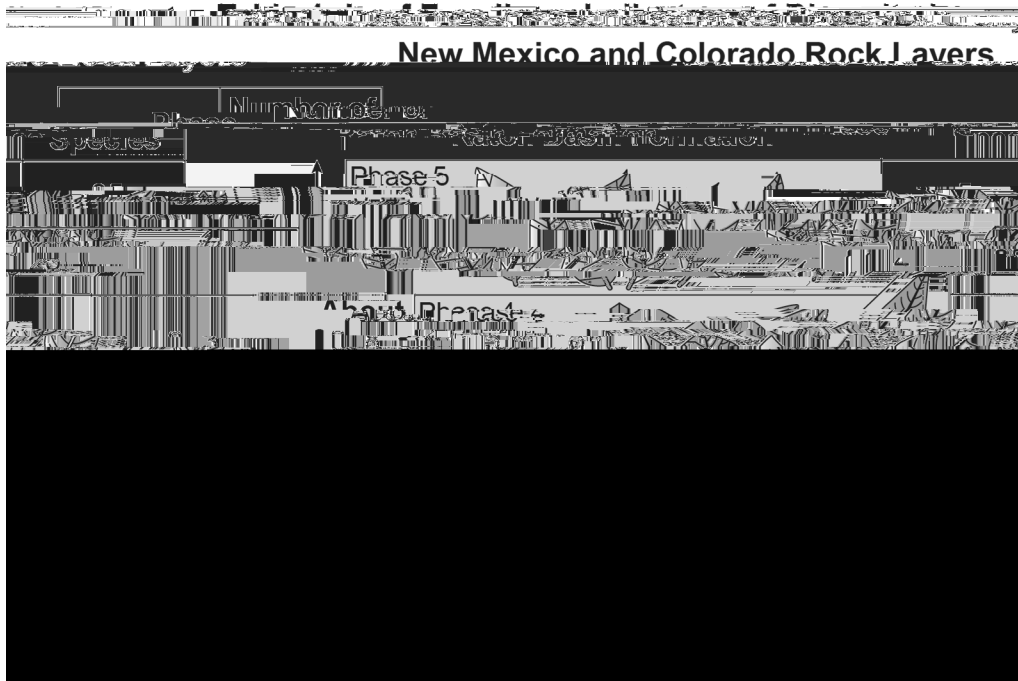
- 1 A possible explanation for why some organisms survived and others did not is that some were
  - (1) herbivores that had a large variety of plants to eat
  - (2) able to evolve quickly into better adapted non-avian species
  - (3) better able to compete successfully after the asteroid impact
  - (4) faster and stronger than others and were able to outrun the blast of the impact
  
- 2 Explain how the evidence provided supports the claim that non-avian dinosaurs went extinct after the impact because of the traits present in their populations. [1]

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When scientists analyzed leaf fossils formed after the asteroid impact, they discovered that the number and types of plants changed over time. They grouped the fossils found in the New Mexico and Colorado rock layers into “phases” of changing diversity. During this time, the environment was gradually warming.






Base your answers to questions 1 through 6 on the information below and on your knowledge of biology.

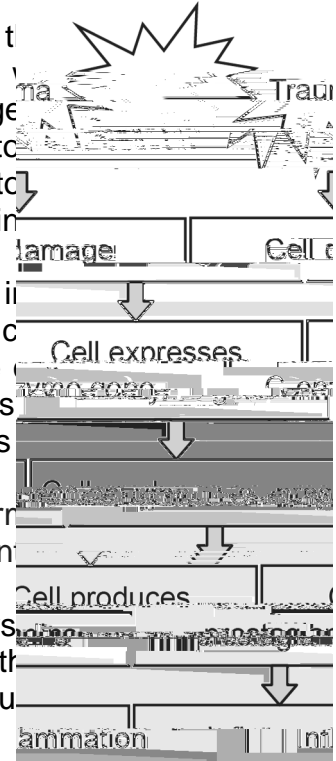
### Prostaglandins: One of the Most Important Molecules You Never Heard of

When cells experience trauma and are damaged, they quickly communicate this damage to nearby cells. One way this is accomplished is by the release of chemical messengers known as prostaglandins. Prostaglandins signal cells to respond with inflammation and pain (the inflammatory response). This, in turn, tells the organism that something is wrong.

Prostaglandins are produced by human cells present in multiple body systems. These include white blood cells, cells of blood vessels, and cells of the digestive tract. These cells produce enzymes. These enzymes signal the cells to produce prostaglandins. The model to the right illustrates this process.

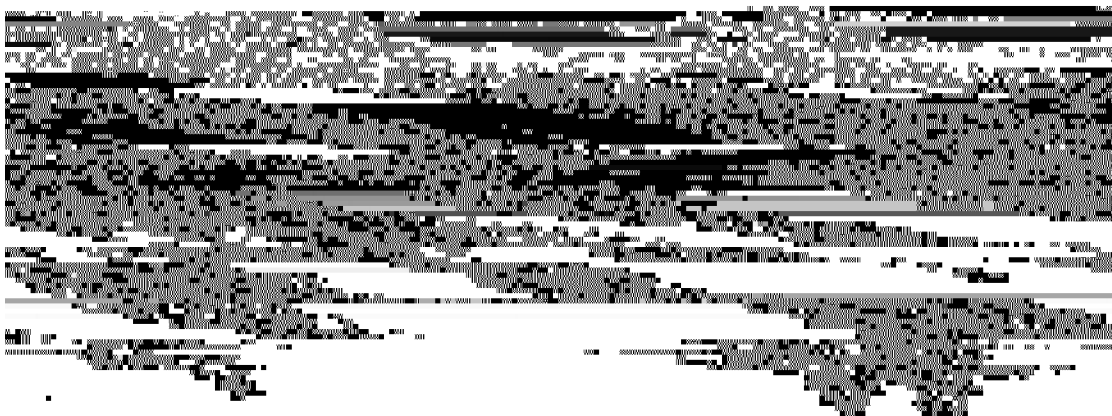
Cyclooxygenase enzymes are present in cells in different forms, including C-1 and C-2. Both forms are expressed in different tissues at different levels.

Ribbon models are often used to illustrate the physical structure of molecules. The ribbon models below represent the two different forms of the C-enzyme that produce prostaglandins.



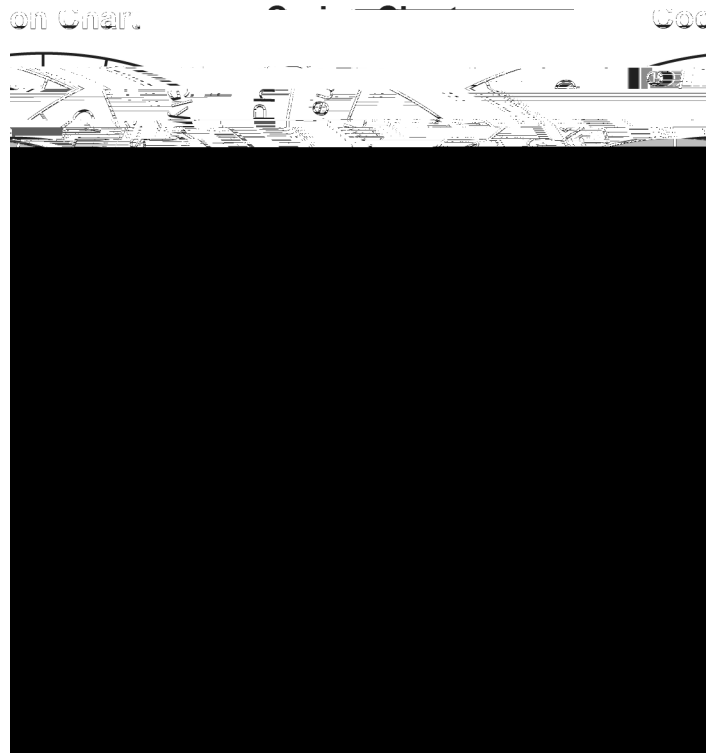
C-1 Enzyme

C-2 Enzyme



- 1 Based on the models, which statement best supports the claim that the two enzymes function differently in tissues due to the amino acid sequence present in the C-1 and C-2 forms of the enzyme?
- (1) The two forms of the C-enzyme result in different DNA sequences that have different shapes.
  - (2) The DNA codes for the production of prostaglandin in molecules that control the production of both C-1 and C-2.
  - (3) The amino acid sequences of both molecules are the same because both are examples of C-enzymes.
  - (4) Each form of the C-enzyme gene produces a different amino acid sequence that results in proteins with different shapes and functions.

In order for a gene to be expressed, such as the gene that codes for the C-enzymes, the cell must follow specific steps. The codon chart below can be used to simulate one step in the process used by the cell when producing the C-enzyme.




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- 6 Describe a qualitative or quantitative constraint that these researchers took into account when using animal models in the design of their experiment. [1]

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