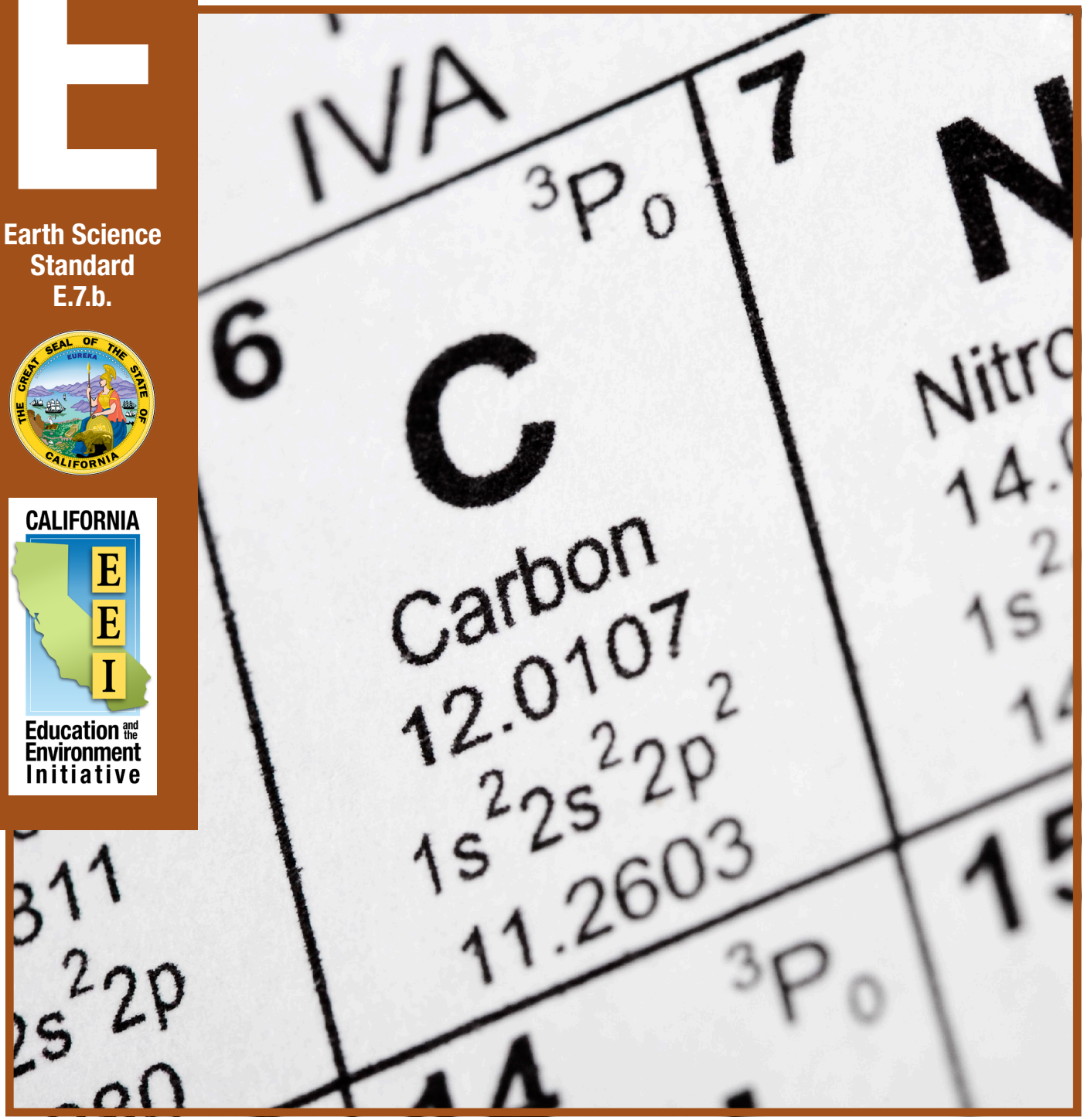
Visual Aids

California Education and the Environment Initiative

Earth Science
Standard
E.7.b.



The Life and Times of Carbon

California Education and the Environment Initiative

Approved by the California State Board of Education, 2010

The Education and the Environment Curriculum is a cooperative endeavor of the following entities:

California Environmental Protection Agency

California Natural Resources Agency

Office of the Secretary of Education

California State Board of Education

California Department of Education

California Integrated Waste Management Board

Key Leadership for the Education and Environment Initiative:

Linda Adams, Secretary, California Environmental Protection Agency

Patty Zwarts, Deputy Secretary for Policy and Legislation, California Environmental Protection Agency

Andrea Lewis, Assistant Secretary for Education and Quality Programs, California Environmental Protection Agency

Mark Leary, Executive Director, California Integrated Waste Management Board

Mindy Fox, Director, Office of Education and the Environment, California Integrated Waste Management Board

Key Partners:

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Office of Education and the Environment

1001 I Street • Sacramento, California 95812 • (916) 341-6769

http://www.calepa.ca.gov/Education/EEI/

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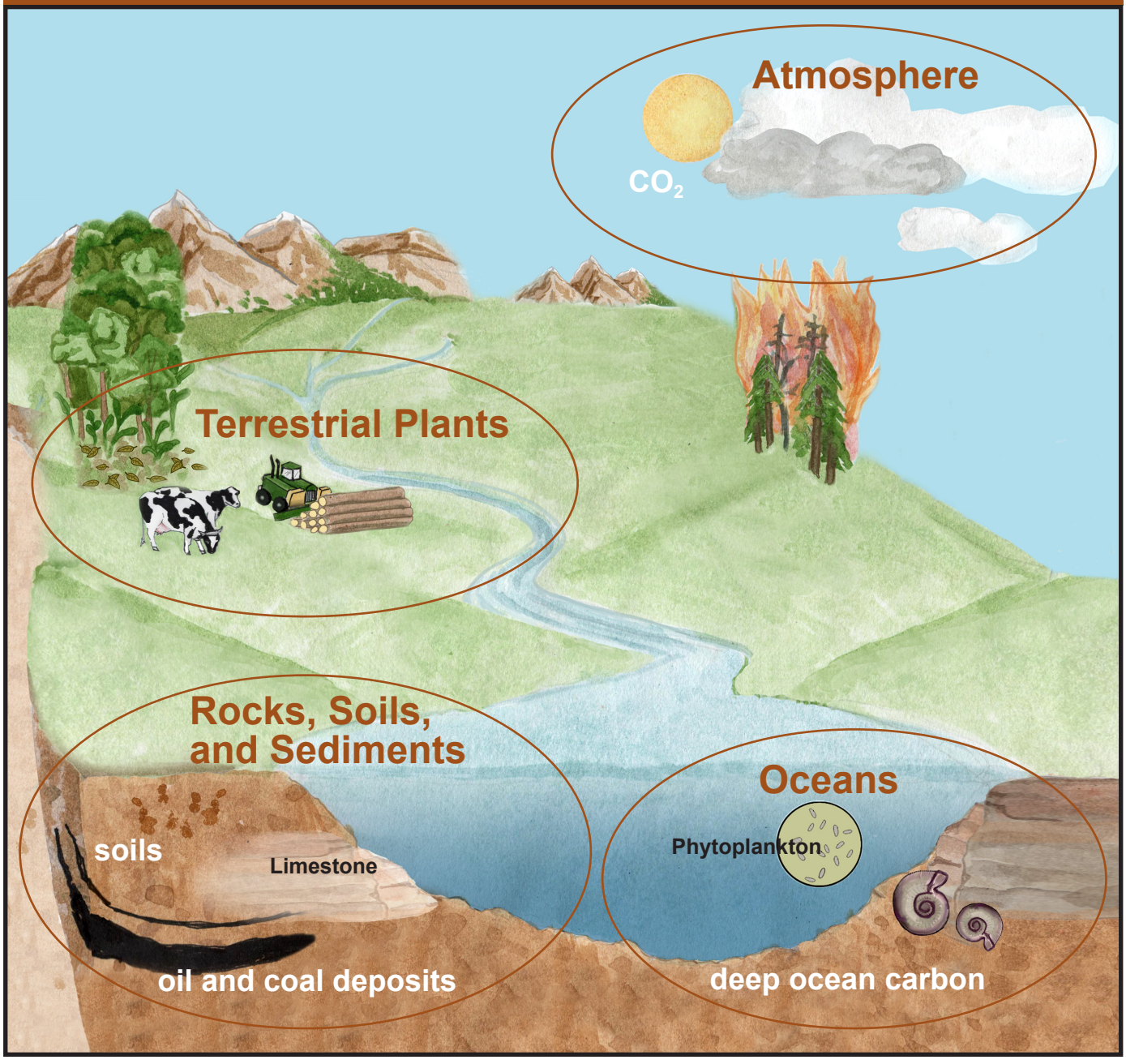
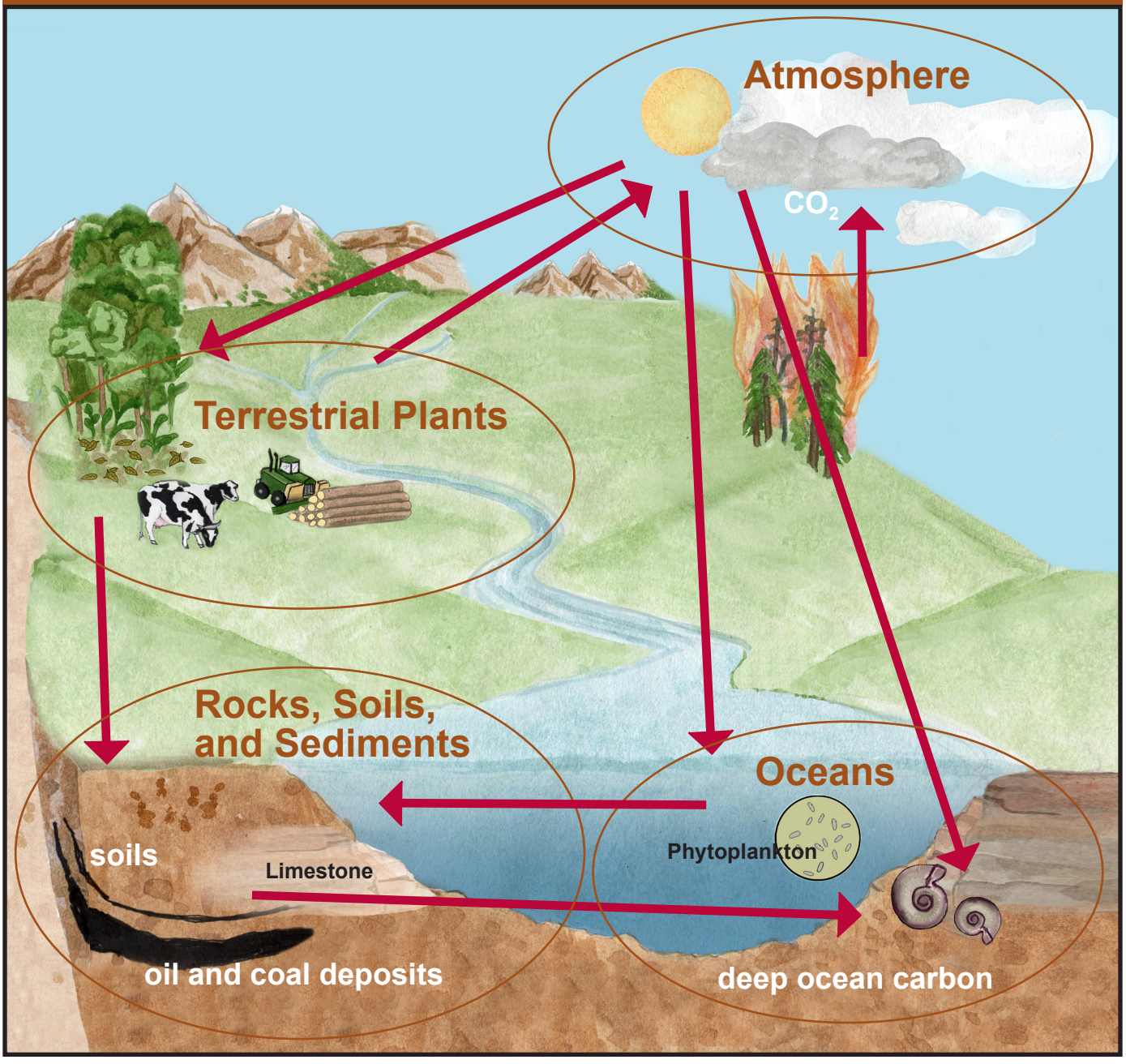
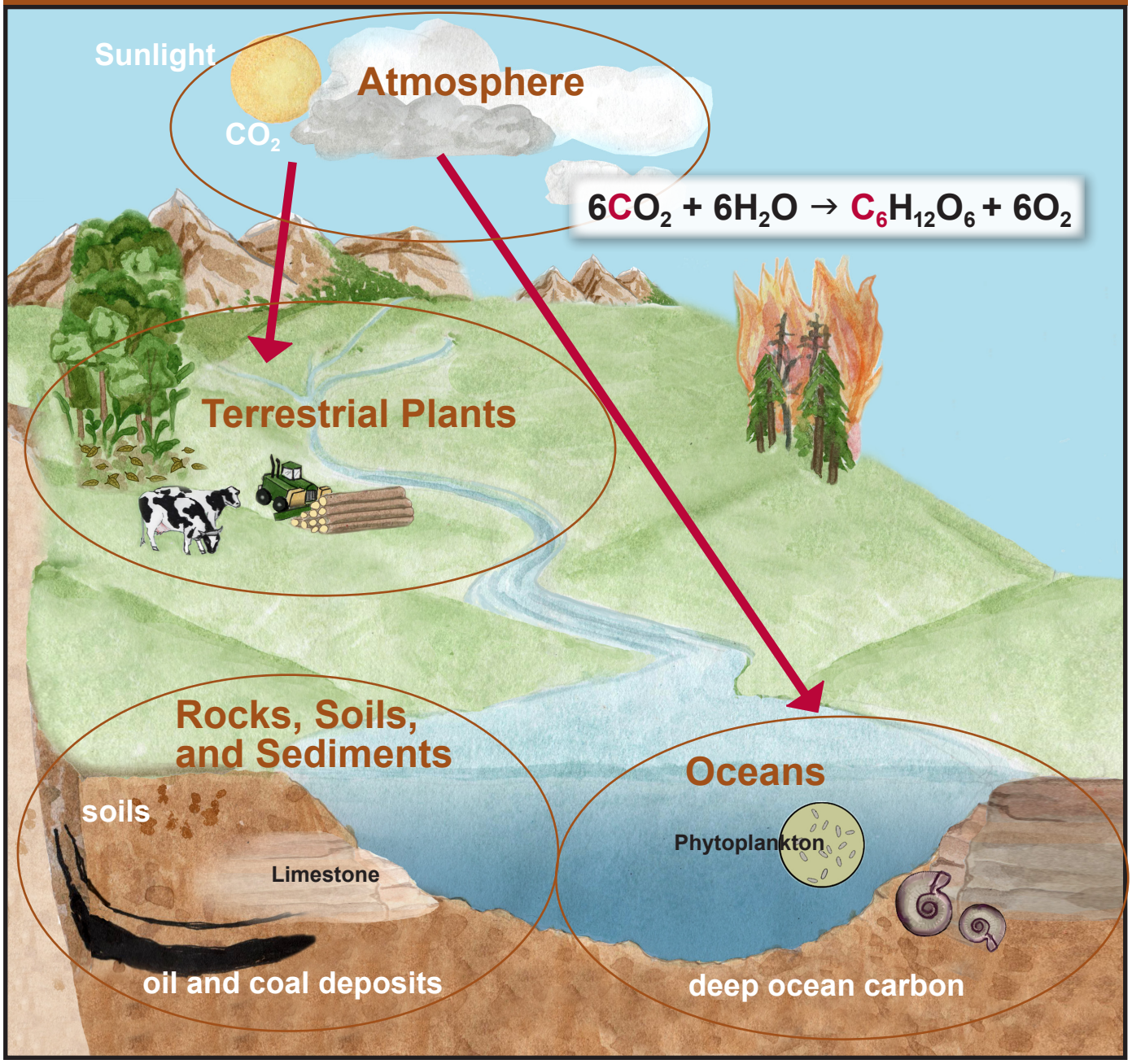


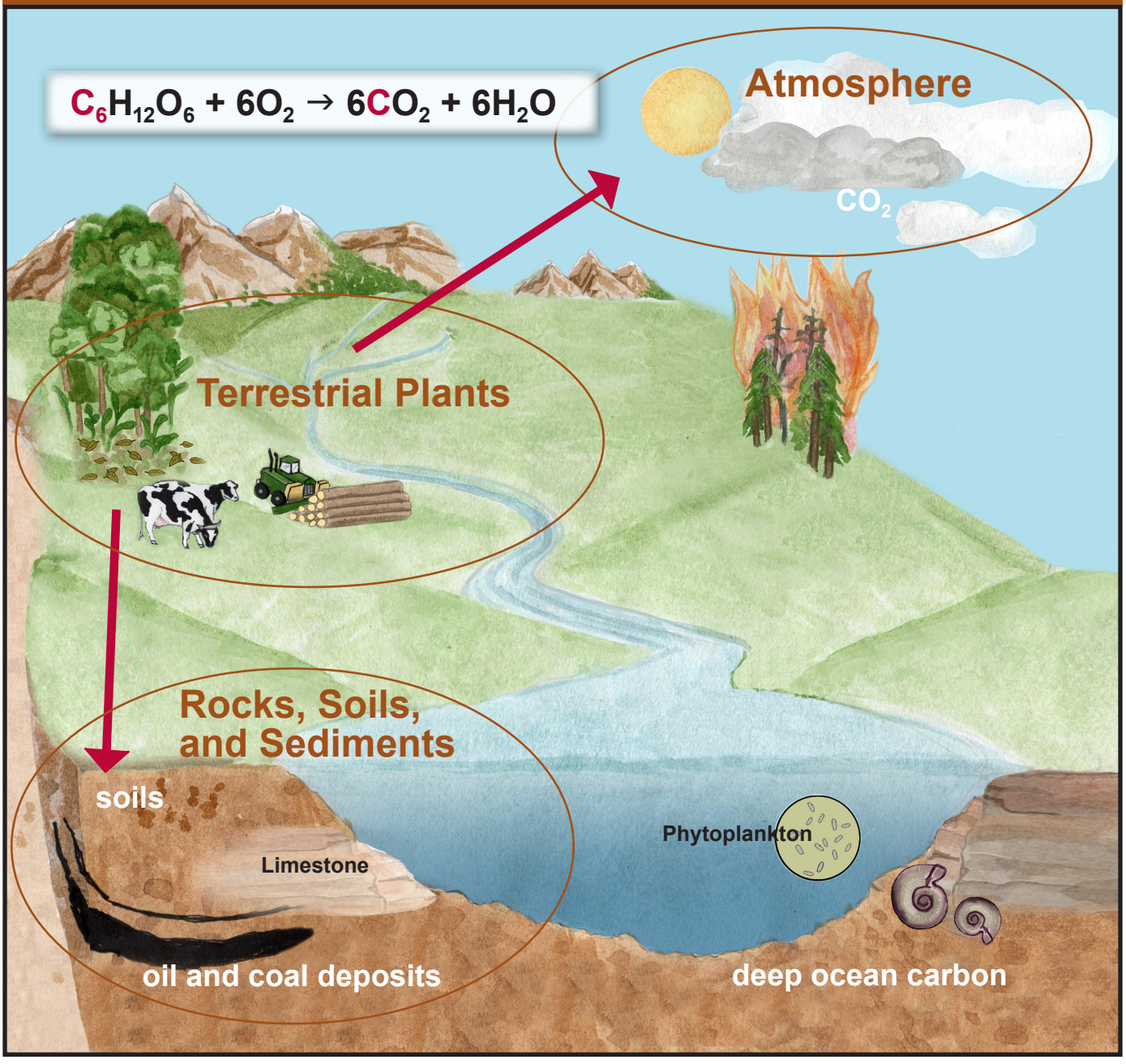
VA #3 Global Carbon Cycle



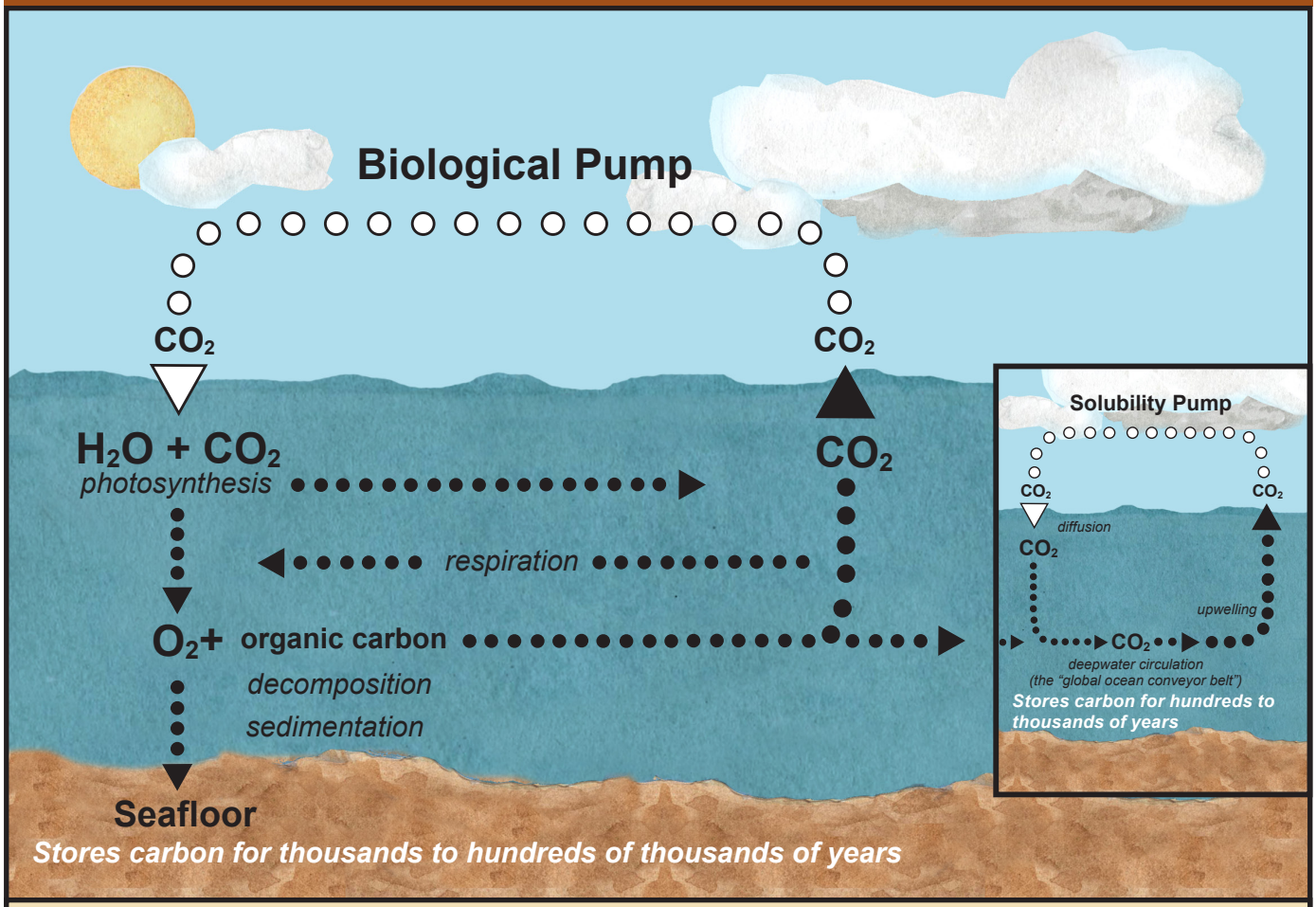
VA #4 Photosynthesis



VA #5 Respiration and Decomposition

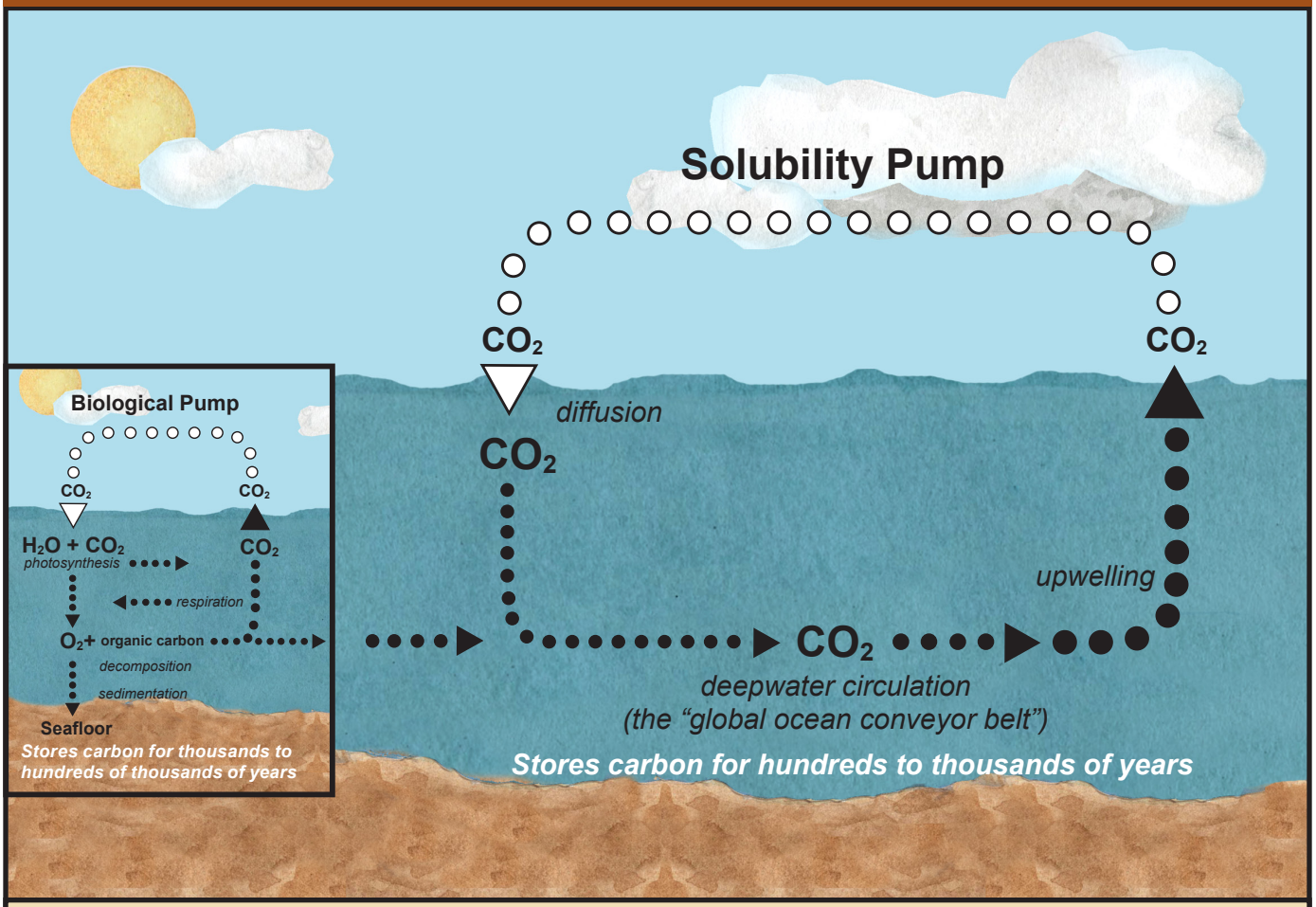


VA #6 Biological Pump



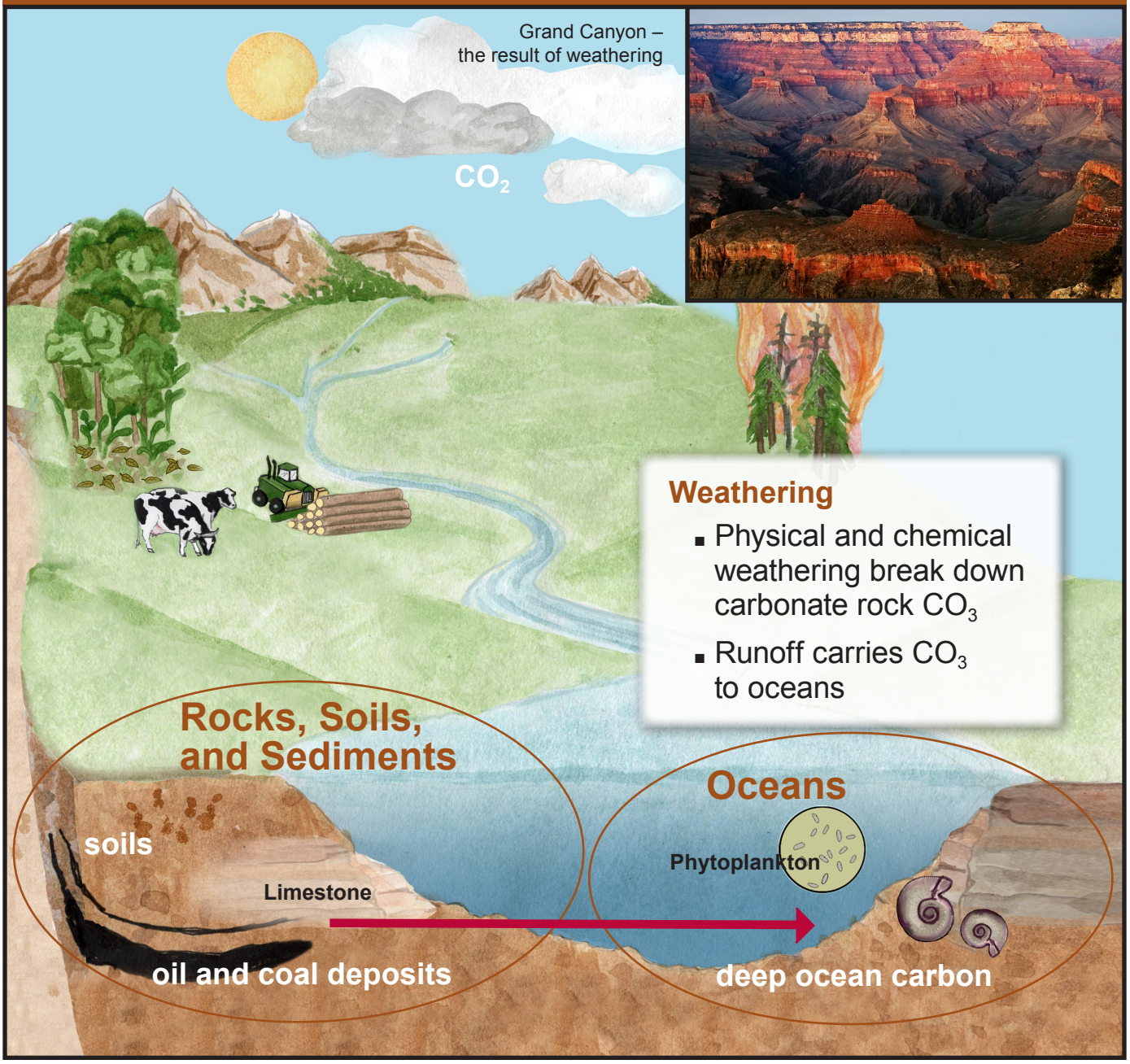
- Marine organisms take up carbonate and calcium, which are combined to form $CaCO_3$ to create shells and skeletons.
- Plants and animals within the marine food web die, decompose, and sink to the ocean floor.

VA #7 Solubility Pump

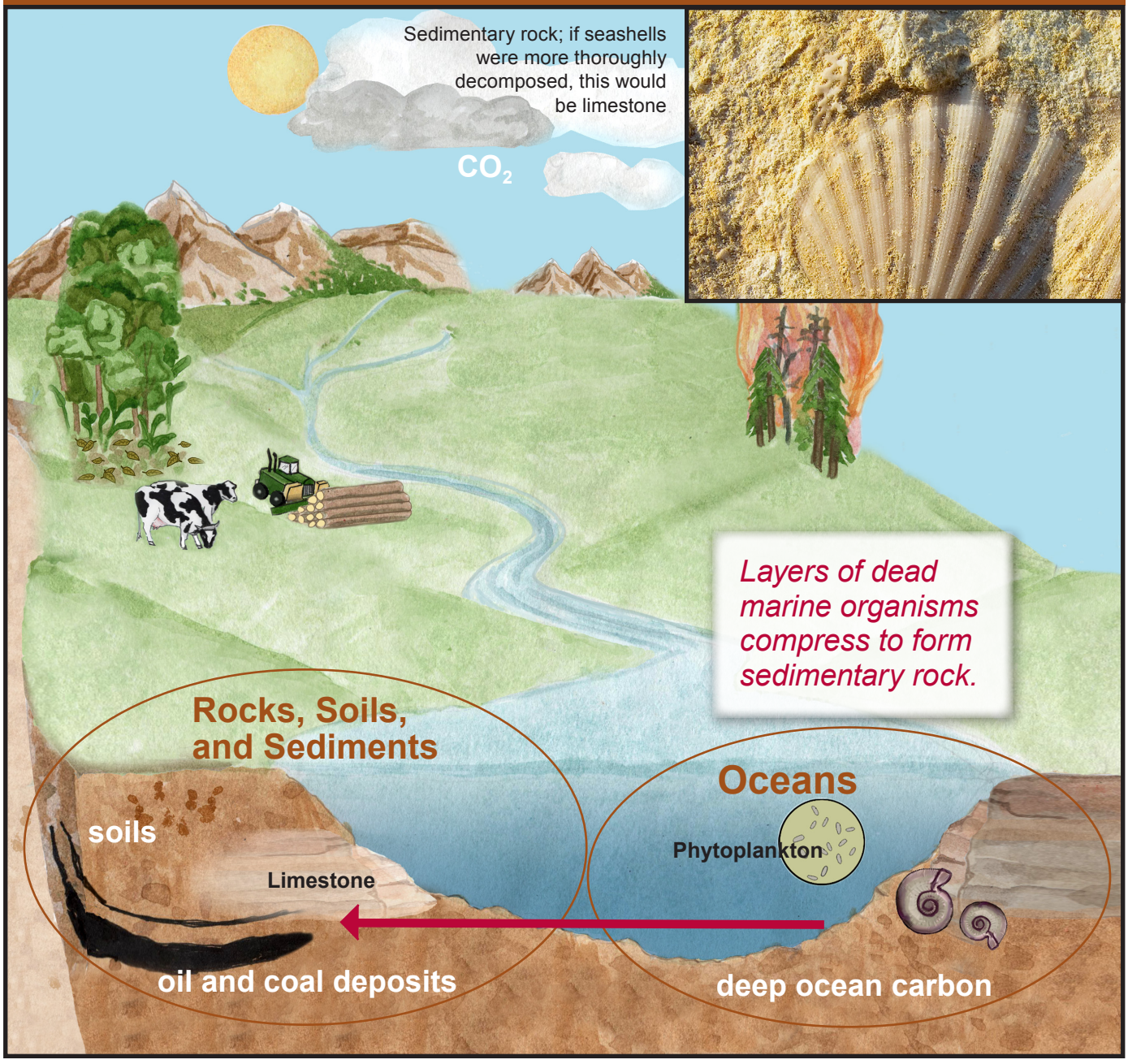


- Diffusion of atmospheric CO_2 into ocean surface water becomes dissolved carbonate (CO_3^{-2}) or dissolved bicarbonate (H_2CO_3).
- Cold water sinks, carrying carbonate to deep ocean.
- The global ocean "conveyor belt" circulates dissolved carbon in deep ocean waters.
- Upwelling carries dissolved carbon back to the surface, and some CO_2 can be released back to the atmosphere.

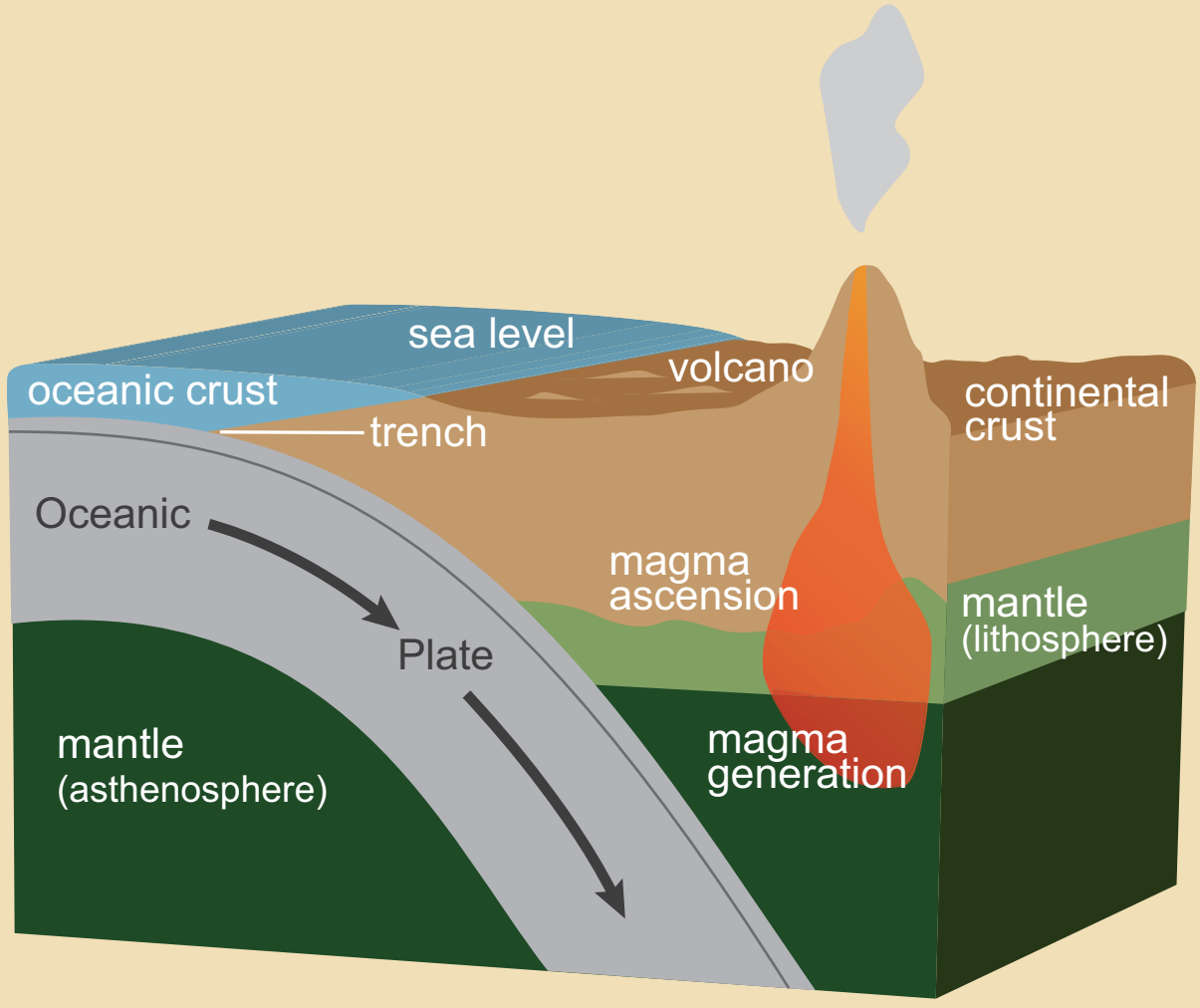
VA #8 Weathering



VA #9 Sedimentation



VA #10 Subduction and Volcanic Eruptions



VA #11 Carbon Flow Observation Log 1

"Carbon flow" is the movement of carbon in gaseous, dissolved, or solid form from one carbon reservoir to another. As you play the Carbon Flow Game, record how you believe carbon flows from reservoir to reservoir as it participates in the global carbon cycle.

Carbon Flow Card	Reservoir: Carbon Started Here	Reservoir: Carbon Moved Here
Feel the Burn		
Seeing the Forest Through the Trees		
Our Changing Landscape		
Fossil Fuels "Old-Growth" Carbon		

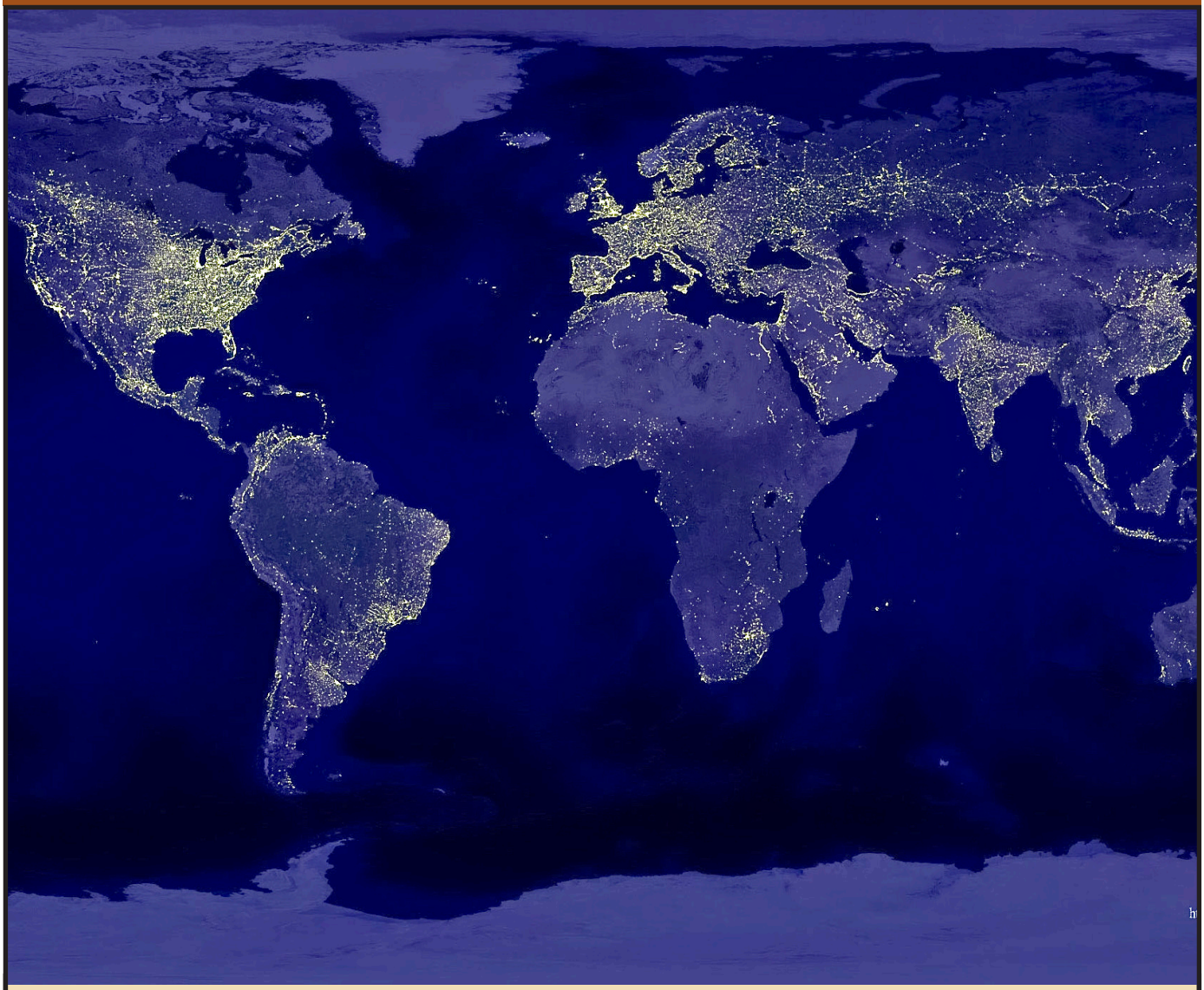
VA #12 Carbon Flow Observation Log 2

Carbon Flow Card	Reservoir: Carbon Started Here	Reservoir: Carbon Moved Here
Pumping Carbon		
How Permanent Is Permafrost?		
A Wetland "Wasteland?"		
Cement, Our Modern Building Block		
Made of Wood Is Good		

VA #13 How Much Is a Metric Ton?

The approximate size of a metric ton of gaseous carbon dioxide in the atmosphere.

VA #14 Earth at Night



The amount of electricity used varies greatly around the world. The bright dots indicate lights.

VA #15 Collecting Firewood

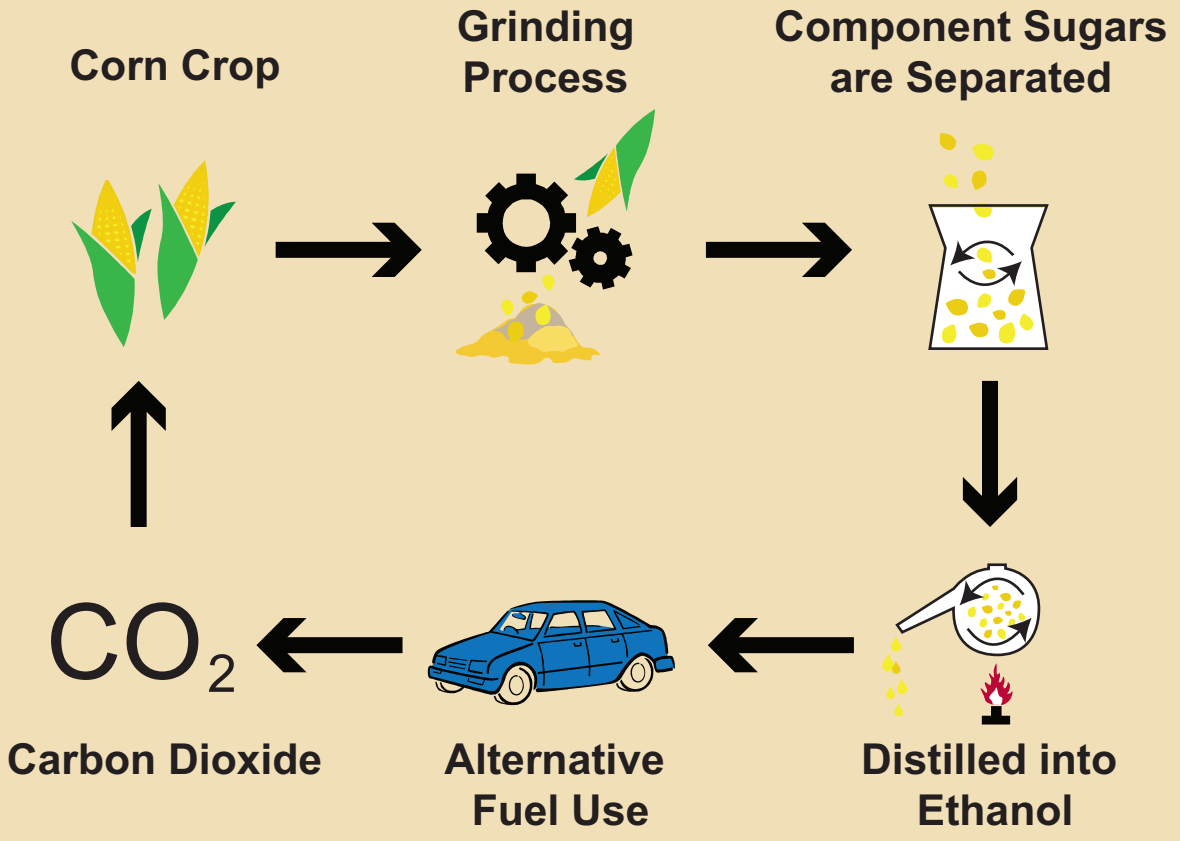
Wood is often collected from great distances to provide fuel for warmth and cooking. Areas near villages in some developing countries have been completely cleared of wood and brush.

VA #16 Yak Dung Dried and Stored for Fuel

In some regions of the world, animal dung is collected, dried, and burned to provide fuel for warmth and cooking.

VA #17 Corn-based Ethanol

Crops like corn are finely ground and separated into their component sugars. The sugars are distilled to make ethanol, which can be used as an alternative fuel that releases carbon dioxide that is reabsorbed by subsequent crops.



VA #18 The Trade-offs of Biofuels 1

With industries searching for new ways to reduce carbon dioxide emissions, biofuels—fuels, such as ethanol made from corn and other plant sources—are becoming an increasingly attractive alternative to petroleum-based fuels.

U.S. biofuel production can help reduce the amount of foreign oil the United States needs to import. The promise of powering our cars with fuels, such as ethanol, made from plants, led President Bush in 2008 to ask Congress for $225 million for biofuels research—a 19% increase over the previous year's federal spending level. This brought more than 300 scientists and business leaders from around the nation to a meeting hosted by the University of California, San Diego to talk about new ways of making ethanol from plants, and other promising benefits of biofuels research.

Everyone seems to be talking about the benefits of biofuels these days: Midwestern farmers, environmentalists, state and federal legislators, Governor Arnold Schwarzenegger, business leaders and investors, and university scientists. But is corn-based ethanol the answer to solving our energy needs? And are the promises of biofuels more hype than real?

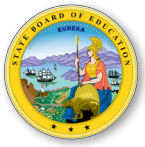
Adapted from an article by Maarten Chrispeels and Steve Kay, *San Diego Union-Tribune*, Feb. 17, 2008.

VA #19 The Trade-offs of Biofuels 2

In this study, your group will be looking at some of the environmental, economic, social, and political trade-offs associated with producing biofuels.

Instructions:

1. Review the news clips.
2. Read each news clip aloud with your group. For each clip, note the source, date, and headline of the news article on your writing paper.
3. Discuss the news clip as a group and answer the questions on **Examining Decision Factors** for each news clip.
4. As a group, select one news clip that you find really interesting. This might be the news clip that your group discussed the most, or one that led to your wanting more information. Prepare a brief report on this news clip. Your group will have one minute to present your report, so you only need to include the points presented in the questions, along with a sentence or two describing why the group found this news clip interesting.



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