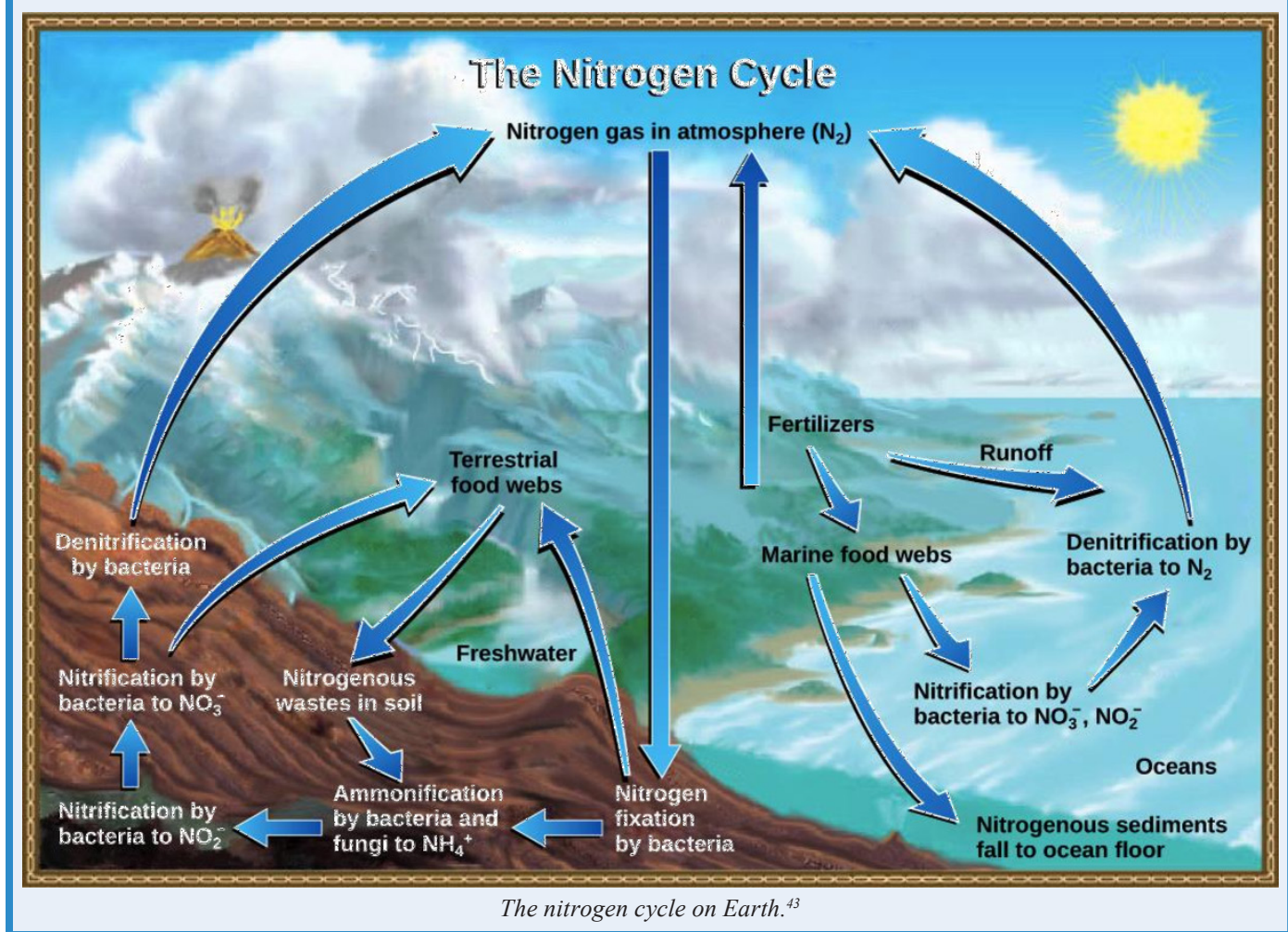


FIGURE 2-5



again. This carbon dioxide is once again available to primary producers. Unfortunately, humans are altering the natural carbon cycle by adding carbon dioxide to the atmosphere. The clearing of forests and the consumption of fossil fuels contributes to increased carbon dioxide in the atmosphere, causing global warming and ocean acidification, which will be discussed in more detail later in this guide.

The Nitrogen Cycle

The nitrogen cycle uses free nitrogen that is present in the atmosphere. However, most organisms cannot use free nitrogen (N_2). In order for algae, plants, and animals to get nitrogen, the nitrogen must be “fixed.” Cyanobacteria, other bacteria, and archaea are capable of performing nitrogen fixation whereby nitrogen is converted into a usable, biologically active form. Nitrogen is fixed with hydrogen or oxygen in the form of ammonia (NH_3), nitrate (NO_3^-), or nitrite (NO_2^-). Then

nitrogen is recycled as animals consume and excrete ammonia and urea. As with the carbon cycle, human activities are interrupting the nitrogen cycle. Through the use of agricultural fertilizers, human and animal waste, and the cultivation of nitrogen-fixing crops, human beings are producing and releasing into the environment more fixed nitrogen than occurs naturally. This results in eutrophication, or the excessive richness of nutrients, in nearshore habitats. Eutrophication will be discussed further in Section IV of this guide.

The Phosphorus Cycle

In the phosphorus cycle, the majority of phosphorus enters the ocean from rivers in the form of phosphate (PO_4^{-3}), though a small amount comes from the atmosphere. In the ocean, primary producers incorporate phosphate into organic matter, which is then passed up the food chain or contributes to detritus or dissolved organic matter (DOM). Phosphorus is