Environmental Microbiology

by

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Microbial Diversity:

1. Microorganisms live in a wide variety of habitats because of their metabolic diversity and

their ability to use a variety of carbon and energy sources and to grow under different

physical conditions.

2. Extremophiles live in extreme conditions of temperature,

acidity, alkalinity, or salinity.

3. Symbiosis is a relationship between two different organisms or populations.

4. Symbiotic fungi called mycorrhizae live in and on plant roots; they increase the surface area and nutrient absorption of the plant.

Soil Microbiology and Biogeochemical Cycles

1. In biogeochemical cycles, certain chemical elements are recycled.

2. Microorganisms in the soil decompose organic matter and transform carbon, nitrogen, and sulfur-containing compounds into usable forms.

3. Microbes are essential to the continuation of biogeochemical cycles.

4. Elements are oxidized and reduced by microorganisms during

these cycles

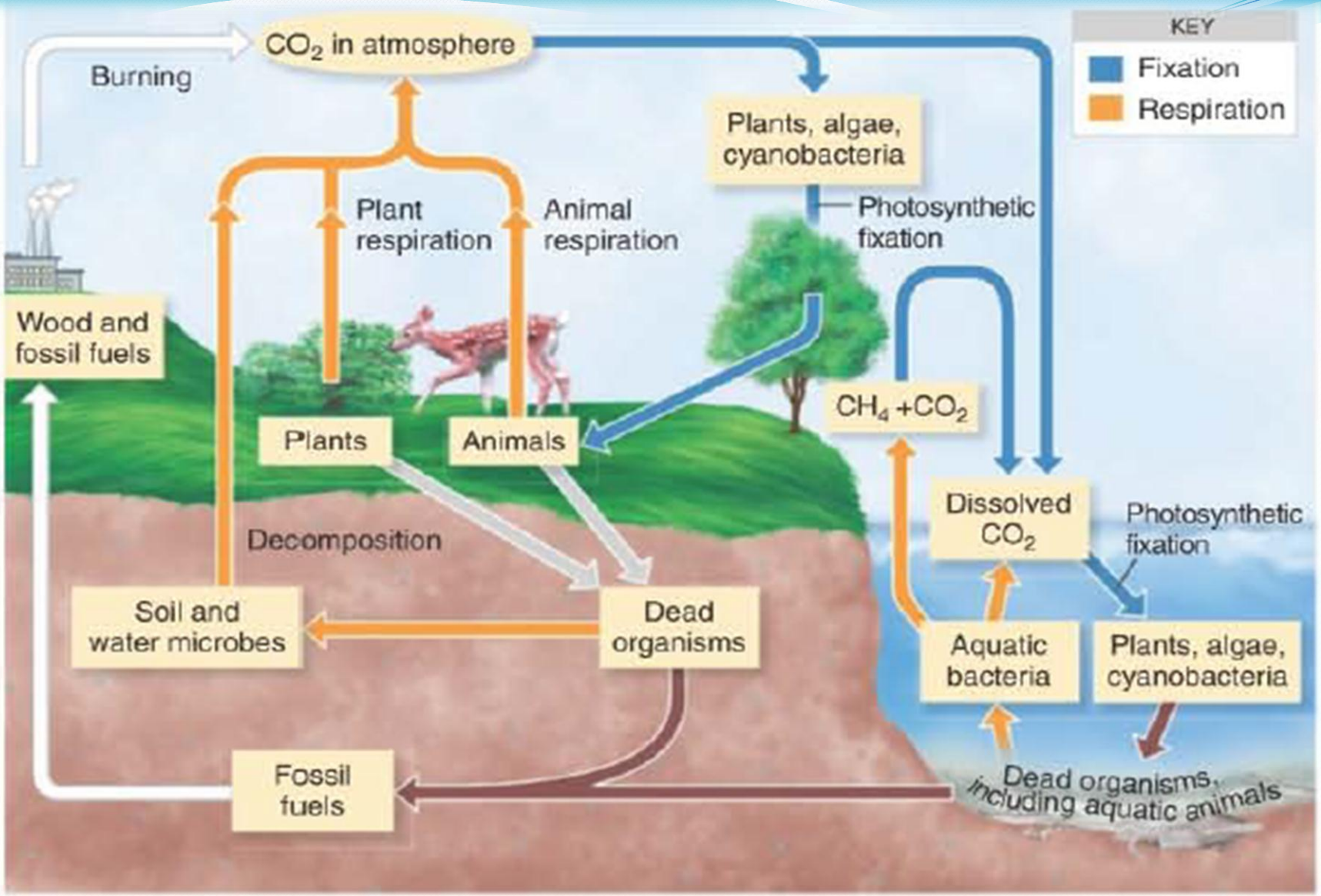

Figure: The carbon cycle. On a global scale. the return of CO2 to the atmosphere by respiration closely balances its removal by fixation. However. the burning of wood and fossil fuels adds more CO2 to the atmosphere: as a result. The amount of atmospheric CO2 is steadily increasing.

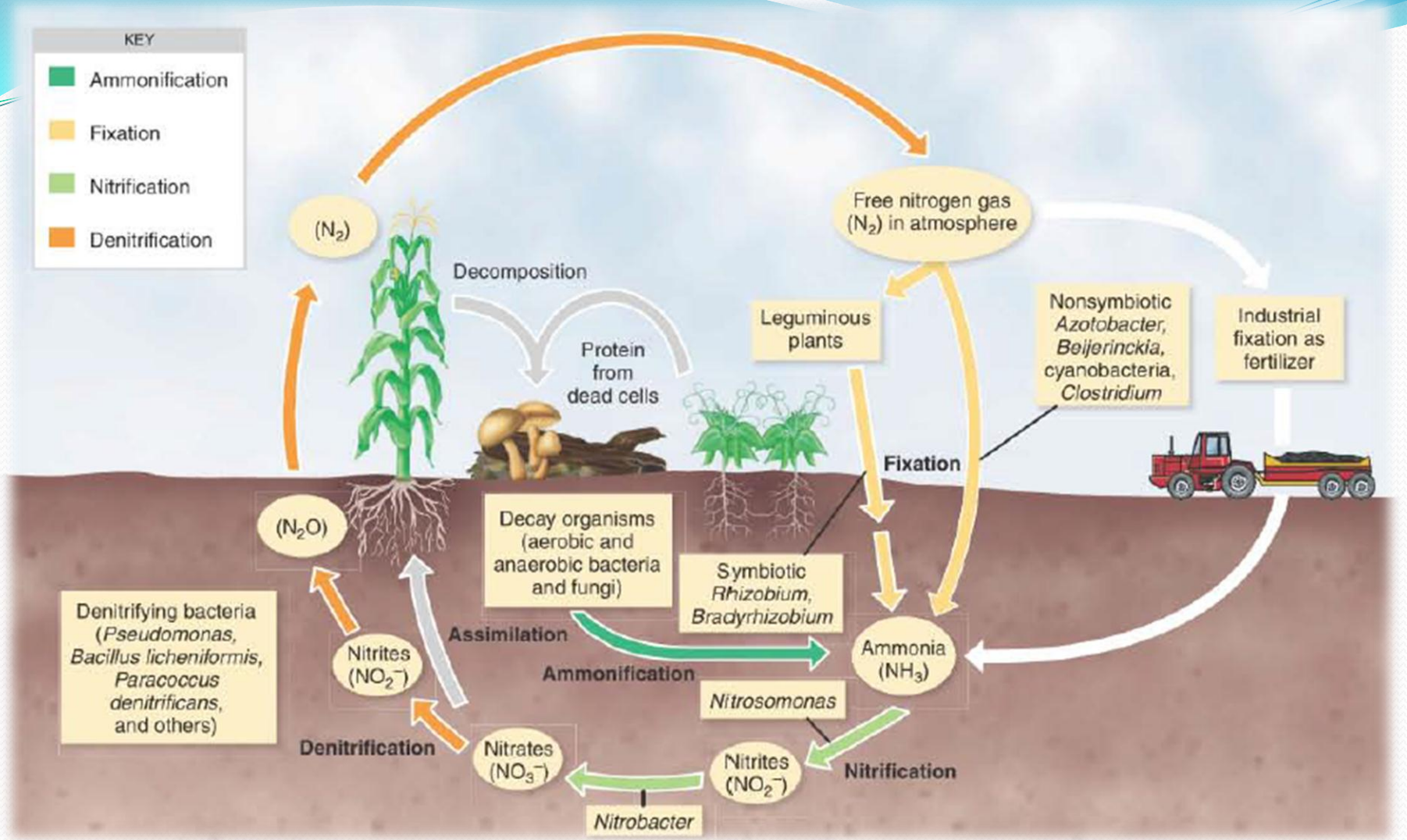

Figure: The nitrogen cycle. In general. nitrogen in the atmosphere goes through fixation, nitrification, and denitrification. Nitrates assimilated into plants and animals after nitnficatlon go through decompositicn. ammonification. and then nitrification again.

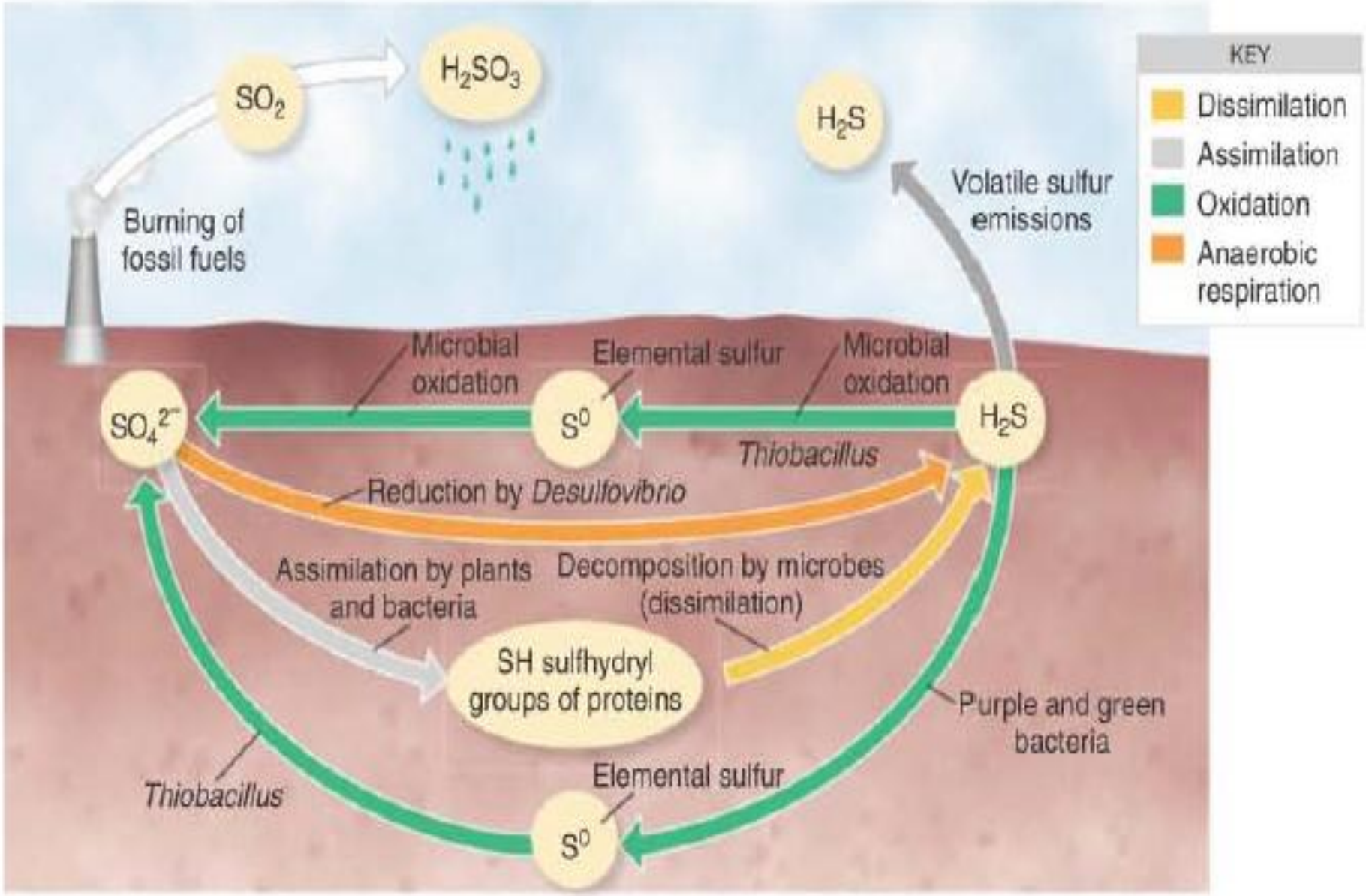

Figure: The sulfur cycle.

The Phosphorus Cycle

1. Phosphorus is found in rocks and bird.

2. When solubilized by microbial acids, the phosphorus is available for plants and microorganisms.

3. Endolithic bacteria live in solid rock; these autotrophic bacteria use hydrogen as an energy source.

Aquatic Microbiology and Sewage Treatment Aquatic Microorganisms

1. The study of microorganisms and their activities in natural waters is called aquatic microbiology.

2. Natural waters include lakes, ponds, streams, rivers, estuaries, and the oceans.

3. The concentration of bacteria in water is proportional to the amount of organic material in the water.

4. Most aquatic bacteria tend to grow on surfaces rather than in a free-floating state.

5. The number and location of freshwater microbiota depend on the availability of oxygen and light.

6. Photosynthetic algae are the primary producers of a lake; they are found in the limnetic zone.

7. Pseudomonas and *Hyphomicrobium* are found in the limnetic zone, where oxygen is abundant.

8. Microbes in stagnant water use available oxygen and can cause odors and the death of fish.

9. Wave action increases the amount of dissolved oxygen.

10. Purple and green sulfur bacteria are found in the profundal zone, which contains light and H2S but no oxygen.

11. Methane-producing bacteria are also found in the benthic zone.

12. Phytoplankton are the primary producers of the open ocean.

13. Archaea predominate below 100 m.

14. Some algae and bacteria are bioluminescent. They possess the enzyme luciferase, which can emit light.

The Role of Microorganisms in Water Quality

1. Microorganisms are filtered from water that percolates into groundwater supplies.

2. Some pathogenic microorganisms are transmitted to humans in drinking waters.

3. Resistant chemical pollutants may be concentrated in animals in an aquatic food chain.

4. Mercury is metabolized by certain bacteria into a soluble compound that is concentrated in animals.

5. Nutrients such as phosphates cause algal blooms, which can lead to eutrophication of aquatic ecosystems.

6. Eutrophication is the result of the addition of pollutants or natural nutrients.

7. *Thiobacillus* produces sulfuric acid at coal-mining sites.

8. Tests for the bacteriological quality of water are based on the presence of indicator organisms, the most common of which are coliforms.

9. Coliforms are aerobic or facultative anaerobic, gram-ve, non-endospore-forming rods that ferment lactose with the production of acid and gas within 48 hours of being placed in a medium at 35°C.

10. Fecal coliforms, predominantly *E. coli,* are used to indicate the presence of human feces.

Water Treatment

1. Drinking water is held in a holding reservoir long enough that suspended matter settles.

2. Flocculation treatment uses a chemical such as alum to coalesce and then settle colloidal material.

3. Filtration removes protozoa cysts and other microorganisms.

4. Drinking water is disinfected with chlorine to kill remaining pathogenic bacteria.

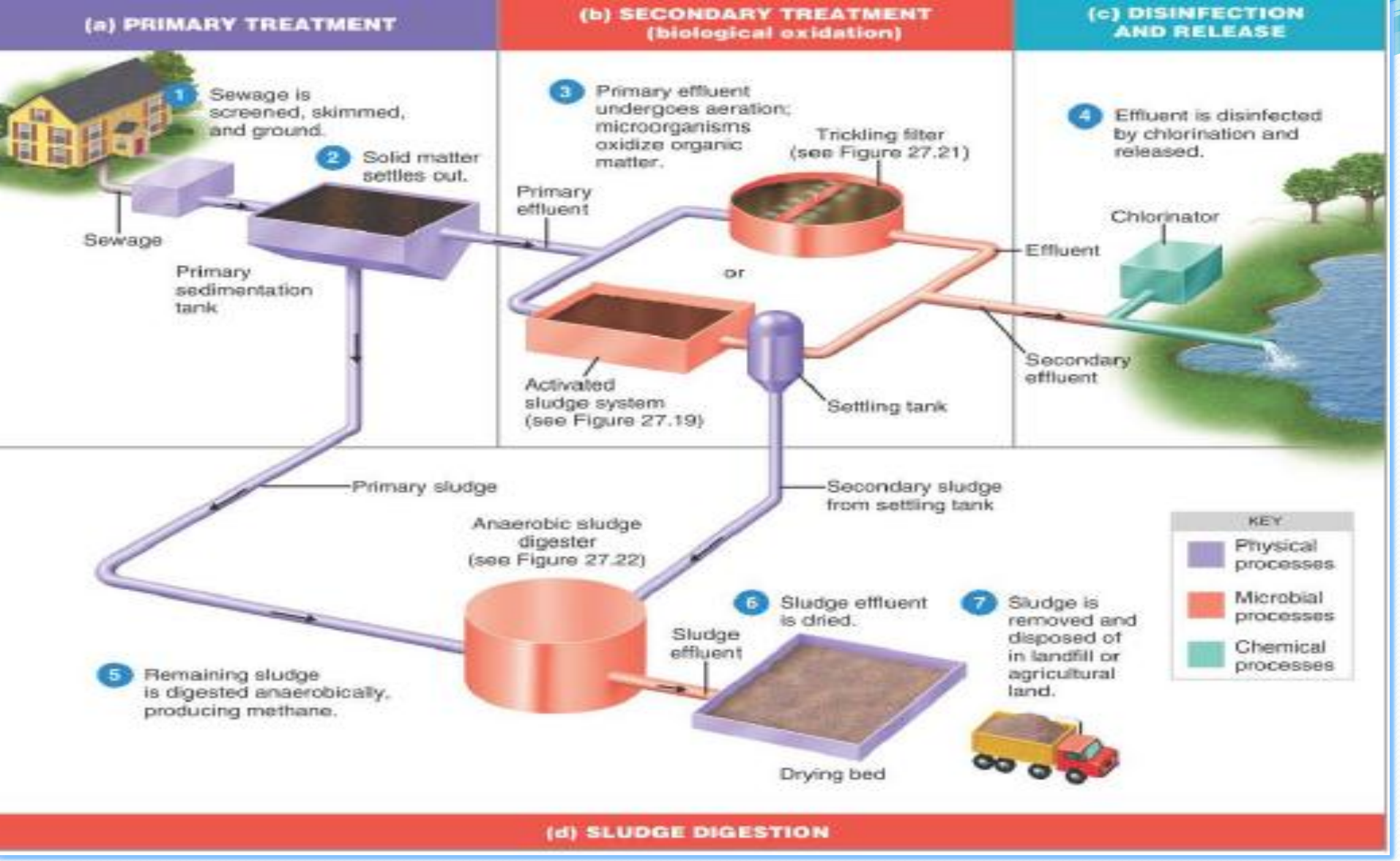

Figure: The stages in typical sewage treatment. Microbial activity occurs aerobically in trickling filters or activated sludge aeration tanks and anaerobically in the anaerobic sludge digester. A particular system would use either activated sludge aeration tanks or trickling filters, not both. Methane produced by sludge digestion is burned off or used to power heaters or pump motors.

Thank you for your attention