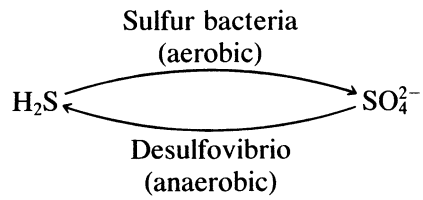
The metabolisms of partner populations must be complementary to yield a mutualistic interaction. An example is the growth of a phenylalanine-requiring strain of *Lactobacillus* and a folic-acid-requiring strain of *Streptococcus* in a mixed culture. Exchange of the growth factors phenylalanine and folic acid produced by partner organisms helps each organism to grow in a mixed culture, while separate pure cultures exhibit no growth. Another example of mutualistic interaction exists between aerobic bacteria and photosynthetic algae. Bacteria use oxygen and carbohydrate for growth and produce CO_2 and H_2O. The algae convert CO_2 to carbohydrates and liberate oxygen in the presence of sunlight.

The reader should note that *symbiosis* and mutualism are not the same. Symbiosis implies a relationship when two organisms live together. A symbiotic relationship may be mutualistic, but it may also be neutralistic, parasitic, commensalistic, and so on.

Commensalism is an interaction in which one population is positively affected by the presence of the other. However, the second population is not affected by the presence of the first population. Various mechanisms may yield a commensal interaction. Two common mechanisms are the following:

1. The second population produces a required nutrient or growth factor for the first population.
2. The second population removes a substance from the medium that is toxic to the first population.

An example of the first type of commensal interaction is the production of H_2S by *Desulfovibrio* (through the reduction of SO_4^{2-}), which is used as an energy source by sulfur bacteria.



An example of the second type of commensal interaction is the removal of lactic acid by the fungus *Geotrichium candidum,* which allows the growth of *Streptococcus lactis.* This interaction is utilized in cheese making using *S. lactis.* Lactic acid produced by *S. lactis* inhibits the growth of the bacteria. The fungus metabolizes lactic acid and improves the growth conditions for *S. lactis.*

Amensalism is the opposite of commensalism. In amensalism, population *A* is negatively affected by the presence of the other population (*B*). However, population *B* is not affected by the presence of population *A*. Various amensal interaction mechanisms are possible. Two common mechanisms are the following:

1. Population *B* produces a toxic substance that inhibits the growth of population *A*.
2. Population *B* removes essential nutrients from the media, thus negatively affecting the growth of population *A*.