Symbiosis \textit{(syn = with; bios = life)}

In common parlance, “being buddies”

In fancy language, a spectrum of interactions between two or more organisms going from mutualism to parasitism
Endosymbionts
Three-dimensional Model of Chloroplast Membranes

- Outer membrane
- Inner membrane
- Granum (stack of thylakoids)
- Thylakoid
- Stroma (aqueous space)
cyanobacteria

plant cell (leaf)
FtsZ ring in chloroplast
Trypanosome (sleeping sickness)
kDNA network from *L. tarentolae*
an aphid having lunch
a bacteriocyte
Red=bacteria  
Blue=aphids  

Dates inferred from aphid fossil record

80-160 Mya
80-120 Mya
30-80 Mya
48-70 Mya
lichens
section through a lichen
nodule formation in a legume

**Figure 19.9**
Morphological changes leading to a nitrogen-fixing nodule.
Figure 4.2
Some bacteria from the rumen of sheep. [From Smiles and Dobson, 1956.]
Leaf-cutting ant on the way home from work
Termite Mound near Darwin
Deep sea
Hydrothermal vents
Worm tubes in deep seavents
Honeyguide bird
Squid with luminescent bacteria
Parasitism
Bdellovibrio
Soil nematodes
Nematode-trapping fungi
*Xenorhabdus* - a murderous partnership with nematodes
How infectious agents can change the behavior of their host
Is this a flower?
this butterfly thought so!
Figure 19.15 Toxoplasma life cycle. Humans and other mammals become infected with Toxoplasma by ingesting inadequately cooked meat containing tissue cysts or by ingesting infectious oocysts excreted in the feces of infected cats (1). Once in the human host, the oocysts mature to tachyzoites (2). Tachyzoites enter the bloodstream and disseminate throughout the body (3). After the initial acute infection, most people mount a successful immune response that eliminates the active infectious (tachyzoite) form of the parasite and leaves only tis-
“summit disease”