

Bug Eating Plants!

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What are plants?



~287,000 species



What are plants?

- make their own energy from sunlight & carbon dioxide
- produce oxygen as a byproduct
- sessile (do not move)
- ~287,000 species



What are plants?

- Are people plants?
- What are we?
- How do we get energy?



Food Chains

- Animals can not make energy from sunlight – we have to get energy from food
- Food comes from either plants, fungi, or other animals



producers, consumers, carnivores, detritivores

Ecosystems

- Food chains describe how energy is transferred



Energy



Producer



Herbivore



Carnivore

- Ecosystems are a group of organisms that interact as producers, consumers, and detritivores, plus all of the non-living parts of the environment

Ecosystems



Ecosystems contain many plants

- Plants compete for sunlight



- by growing tall



- or by growing in places where other plants can not grow

Pale Pitcher Plant (*Sarracenia alata*)

- both a producer (sunlight and CO_2 into energy + O_2) and a consumer
- this carnivorous plant eats bugs!
- **mostly ants**, who are attracted to the plant because it smells good and produces nectar
- There are ~10 species of *Sarracenia*, all in Eastern North America

All are pitcher plants, with a similar shape.



Can you find the Sarracenia?



Sarracenia Pitcher Plants



Sarracenia flava (l)

S. oreophila (r)



Sarracenia Pitcher Plants

Sarracenia purpurea



Other Pitcher Plants

Darlingtonia californica



Heliamphora chimantensis

Other Pitcher Plants

Nepenthes spp.



Other Carnivorous Plants



Drosera spp.

Sundews





Other Carnivorous Plants



Dionaea muscipula

Venus Fly Trap



Bladderworts



Utricularia macrorhiza

Bladderwort



parts

Utricularia macrorhiza

Bladderwort



Why eat bugs???

Scientists believe that carnivory allows plants to grow in low nutrient soil.

Plants need nitrogen and phosphorus to grow; digesting bugs seems to provide *Sarracenia alata* and other species with these minerals.

Since all plants compete with other plants for sunlight, this may give *Sarracenia* an advantage that allows it to grow in areas that are difficult for other plant species.

Does carnivory help plants to grow?

How does *Sarracenia* turn bugs into N and P?

Species



Canis adustus



Canis lupus



Canis lupus familiaris

Species are types of organisms - cohesive reproductive groups of individuals:

- members of the same species can produce viable offspring
- members of different species can not produce viable offspring

Phylogeny



jackal



African wild dog



coyote



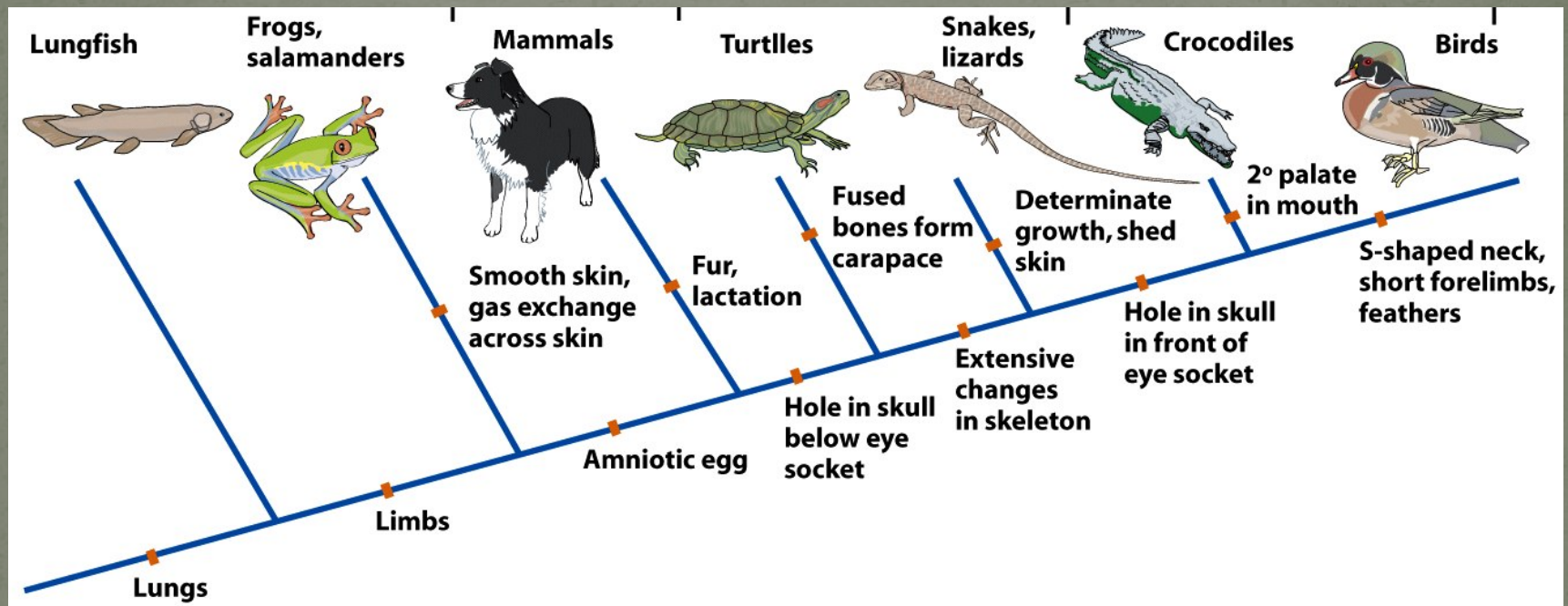
wolf

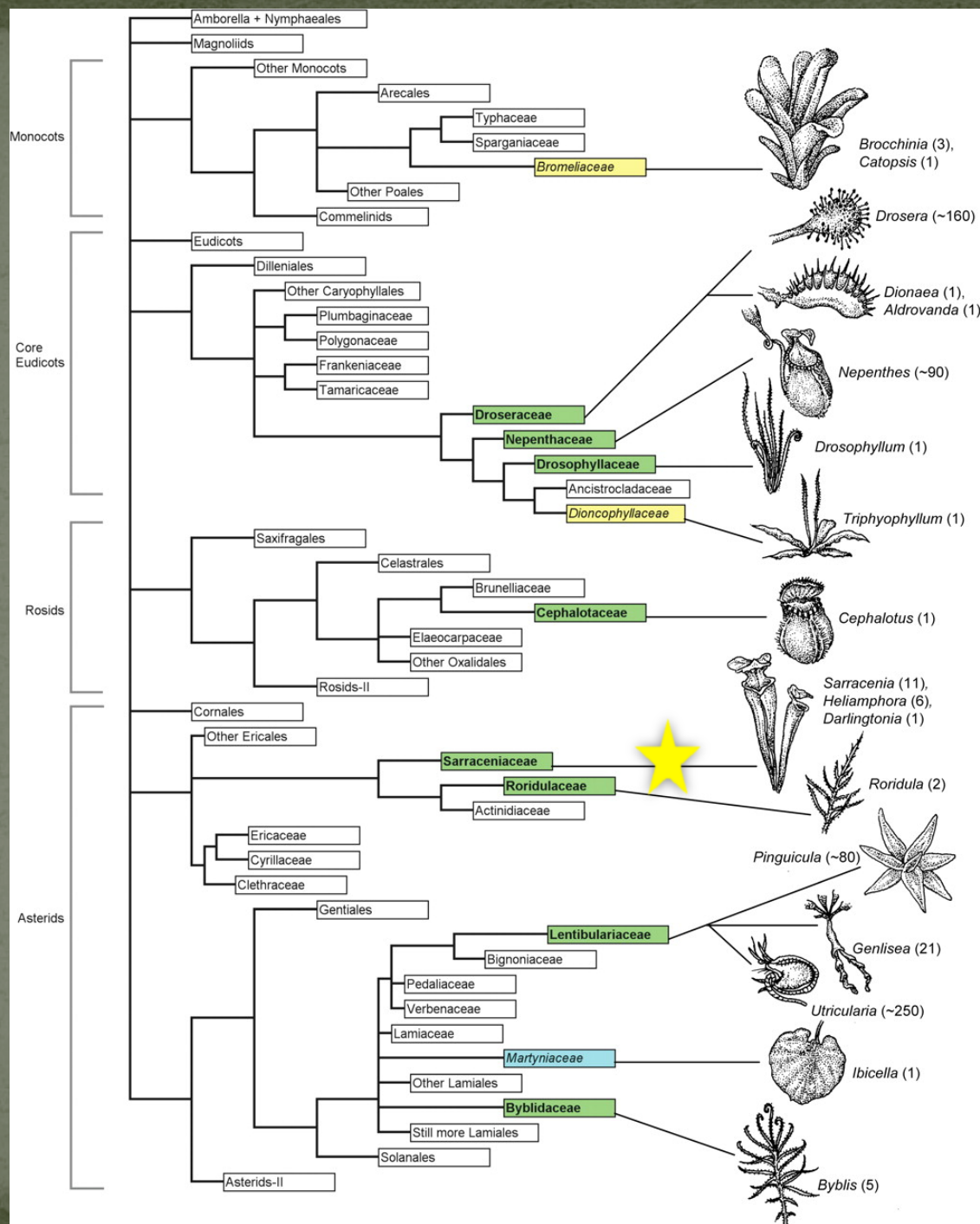


dog

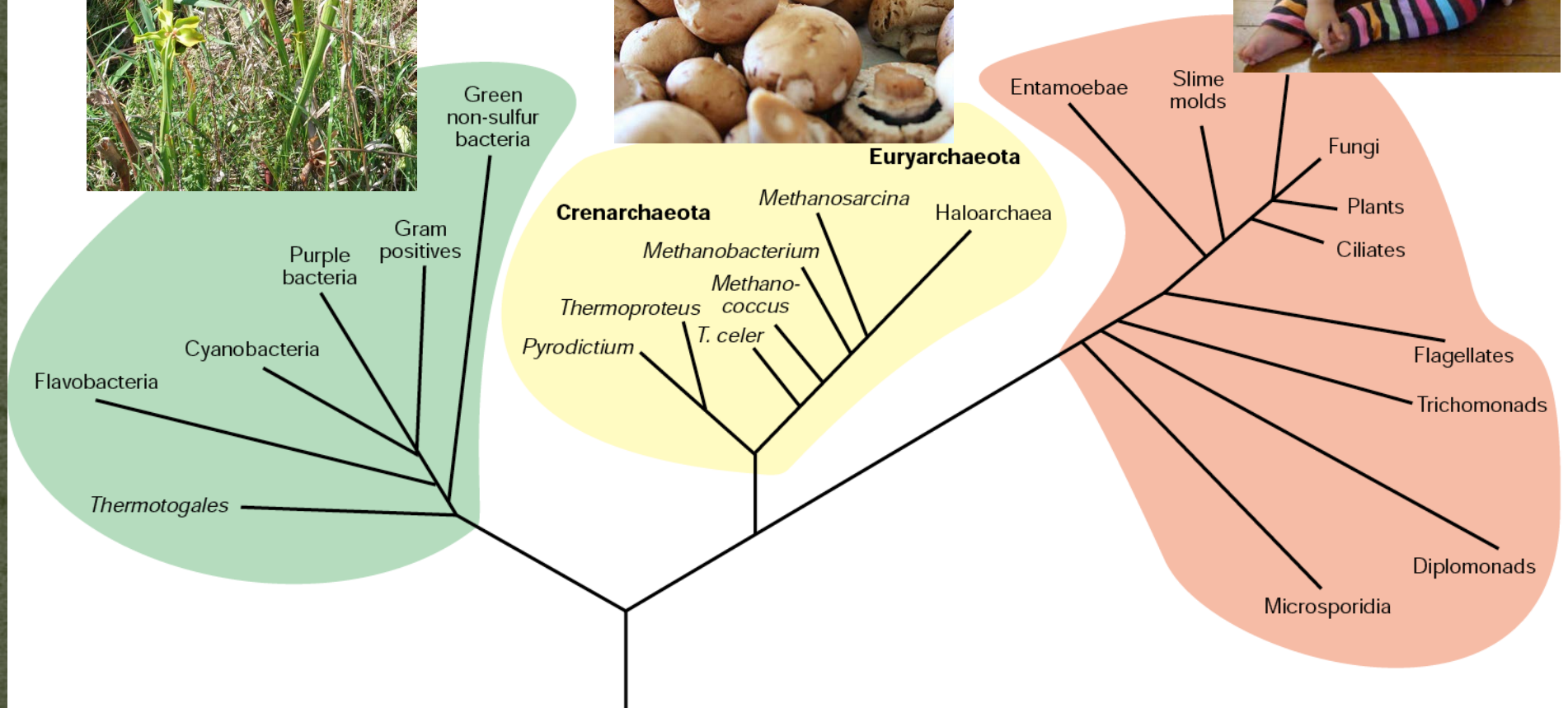


Phylogeny

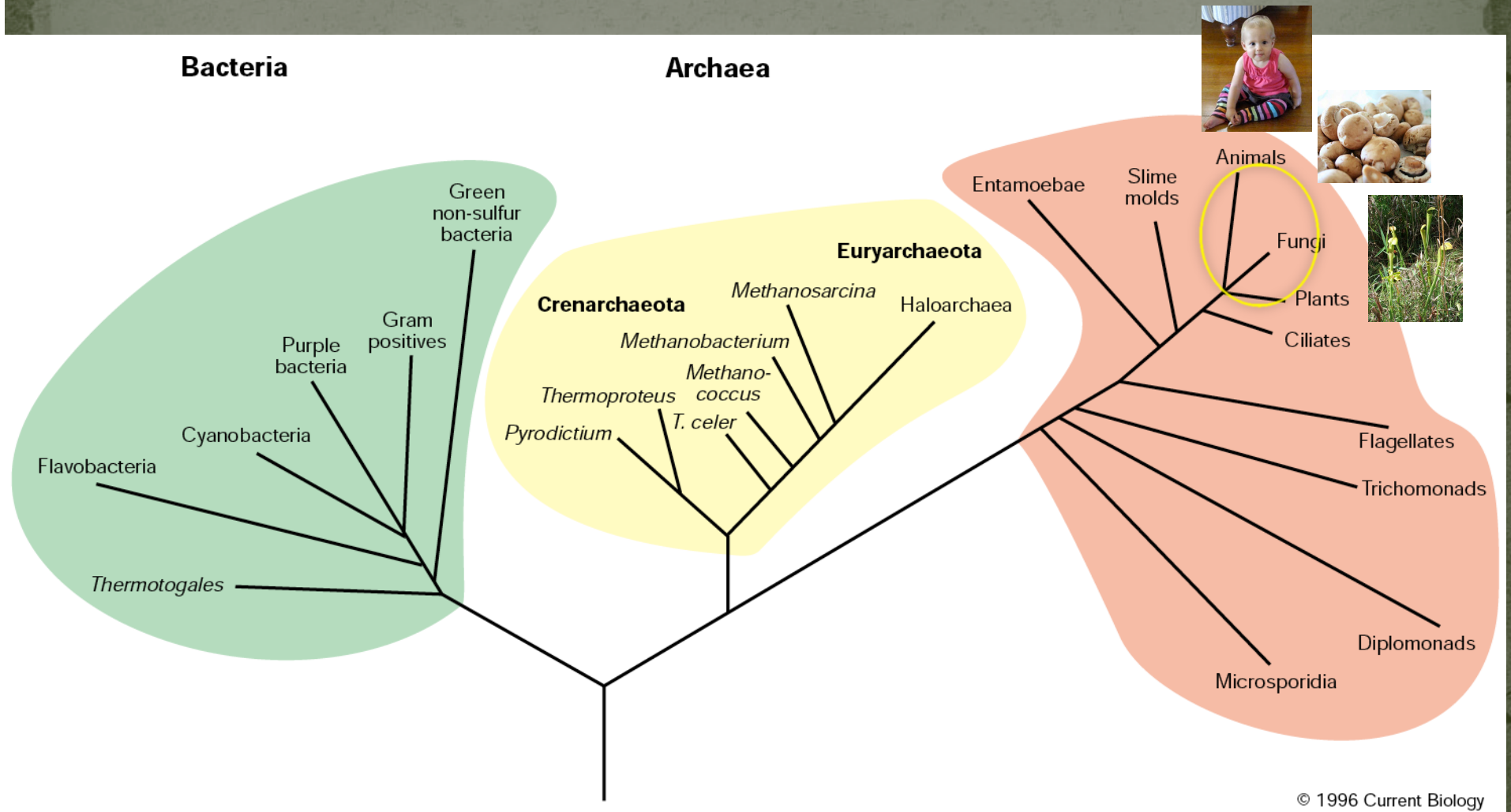




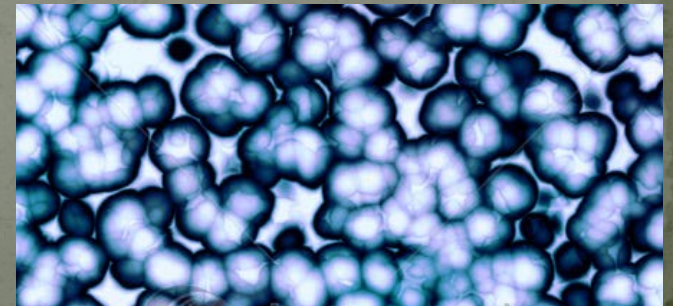
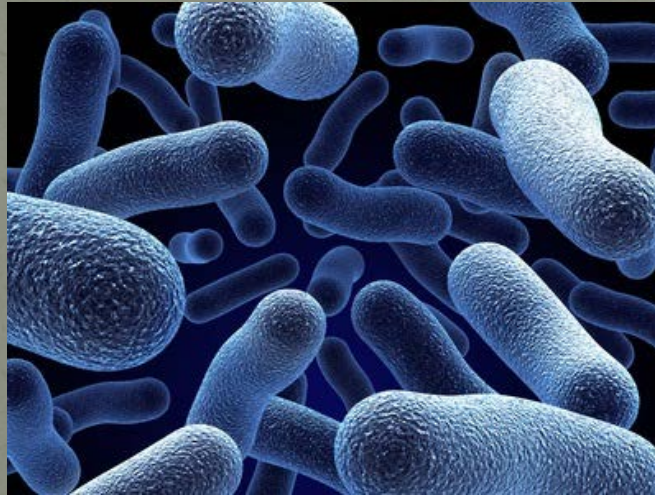
Ellison and Gotelli 2009



Phylogeny



Microorganisms



Microorganisms

Bacteria can make you sick:

Streptococcus (sore throat)

S. pneumoniae (flu)

Mycobacterium tuberculosis (Tuberculosis)

Campylobacter jejuni (diarrhea)

E. coli (food poisoning)

**Please wash your hands with soap & cover
your mouth when you sneeze!**



Microorganisms

But bacteria and other microorganisms are also helpful

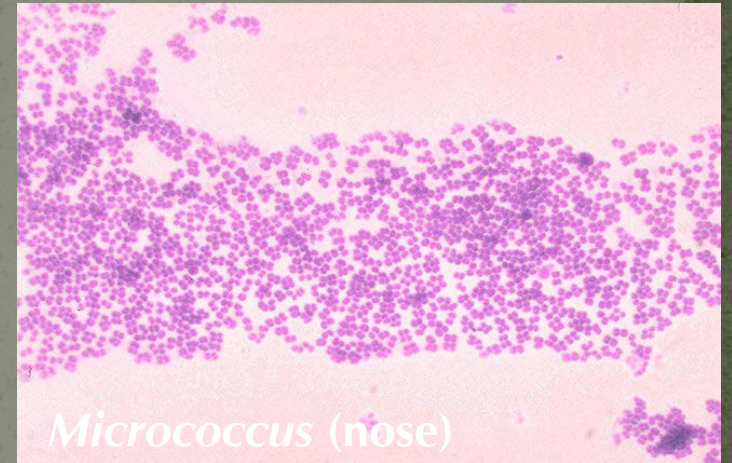
~500 species of bacteria in/on your body!

More than 100 trillion bacterial cells in/on your body
(only about 10 trillion human cells)

Most of these are benign; many may be beneficial.

However, disruptions in your microbiome may be harmful; obesity is associated with a disruption in the balance between two dominant types of bacteria, the *Bacteroidetes* and the *Firmicutes*.

Enterococcus faecalis (gut)



Microorganisms & S. alata



Microorganisms & *S. alata*

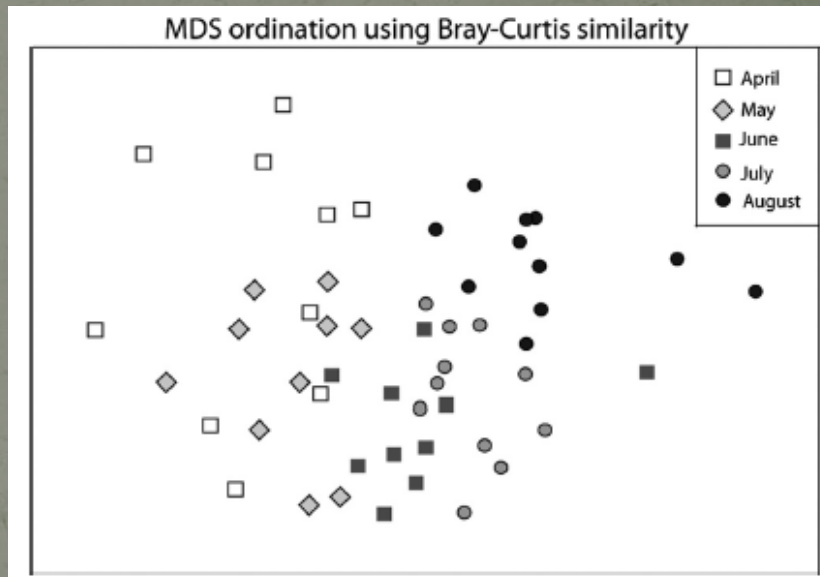
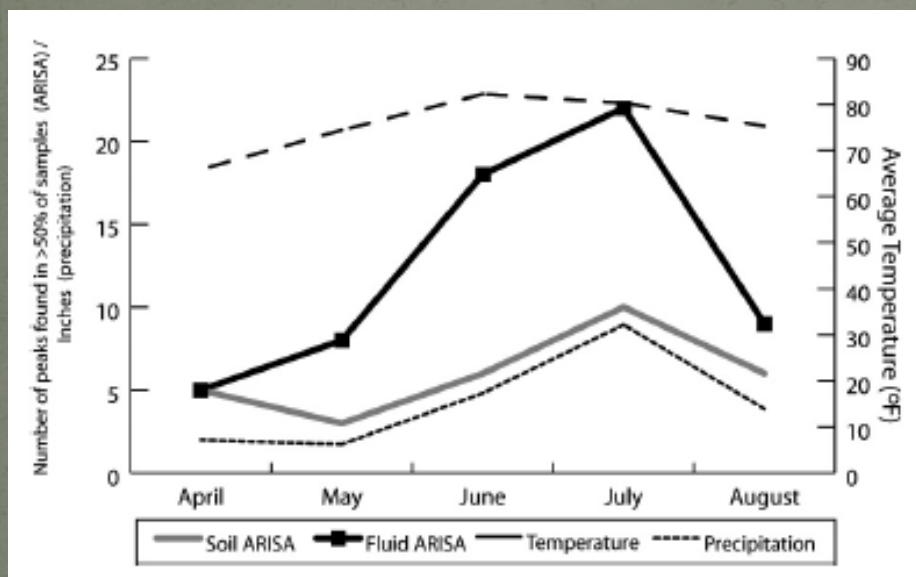


The Carnivorous Pale Pitcher Plant Harbors Diverse, Distinct, and Time-Dependent Bacterial Communities^{∇†}

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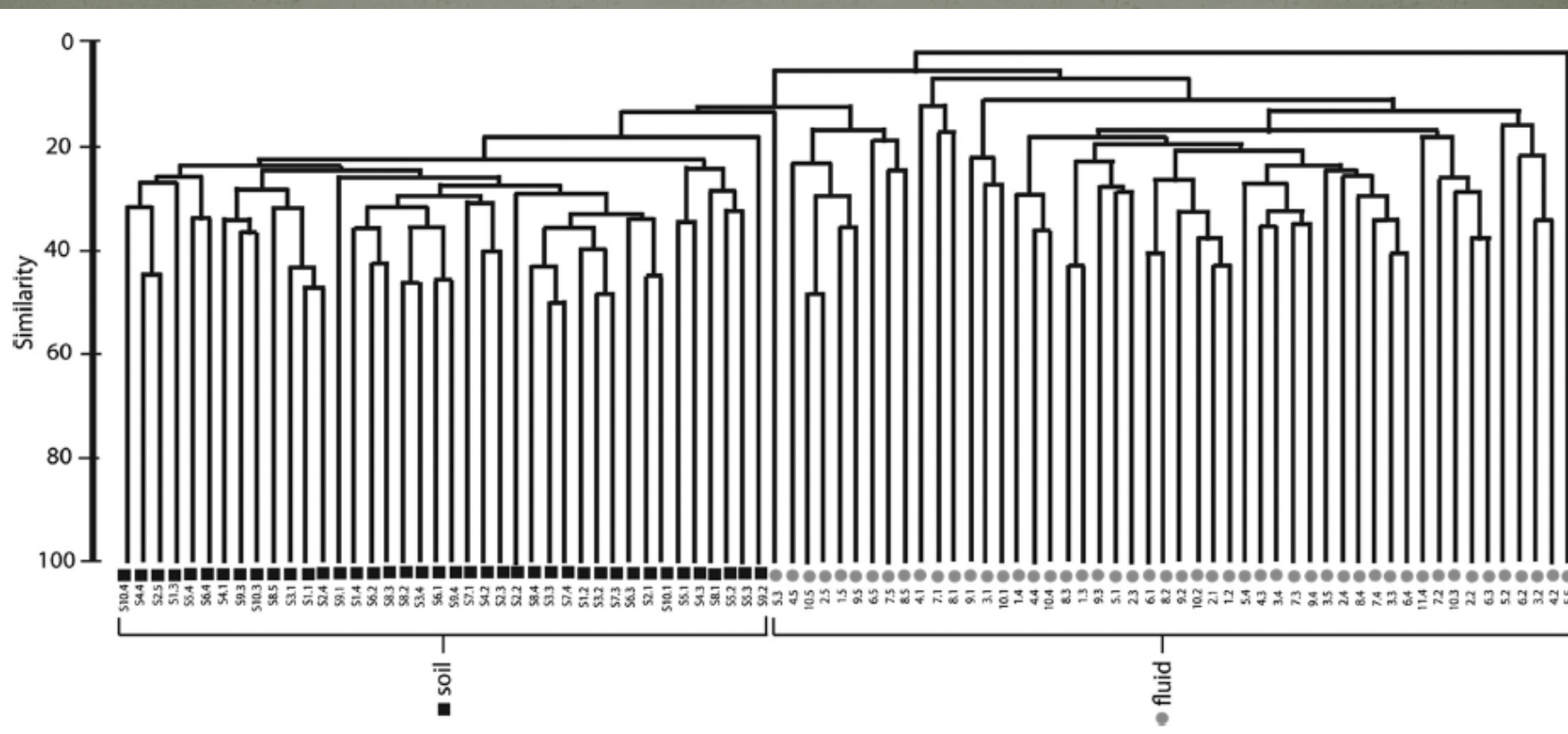
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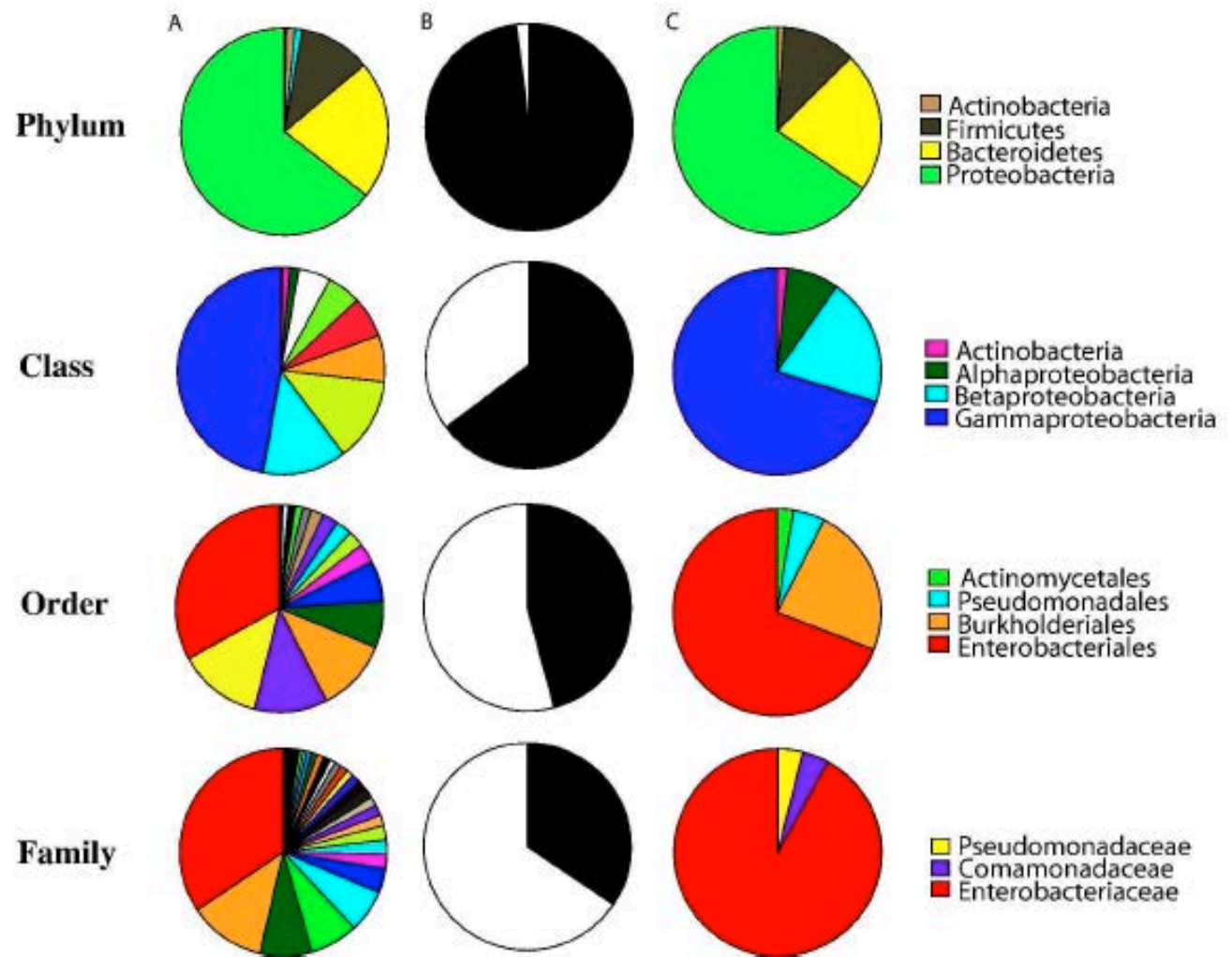
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Plant genetic divergence predicts microbial community structure: insights from the microbial *phylogeography* of carnivorous pitcher plants

Margaret M. Koopman^{1,2} and Bryan C. Carstens^{1,*}

383,660 DNA
sequences
(16s rRNA gene)



all sequences

ubiquitous
idiosyncratic

Taxonomy (ubiquitous)



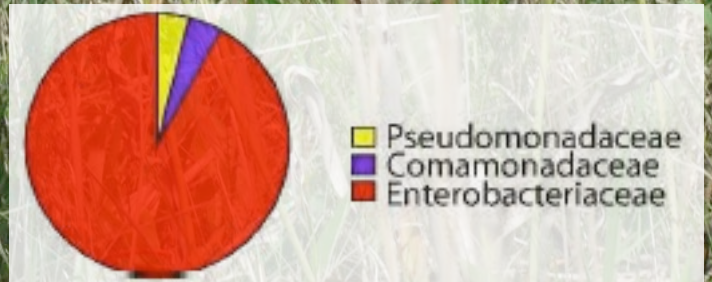
Microorganisms & *S. alata*

A large proportion of the bacteria that we find in *S. alata* are found in all of the plants that we sample.

Most of these bacteria are members of the Enterobacteriaceae, a family that is usually found in animal guts (including your own).

Question: What is the origin of the *S. alata* bacterial fauna?

Origin of S. alata bacteria?



Could these bacteria come from the ants that the plants eat??

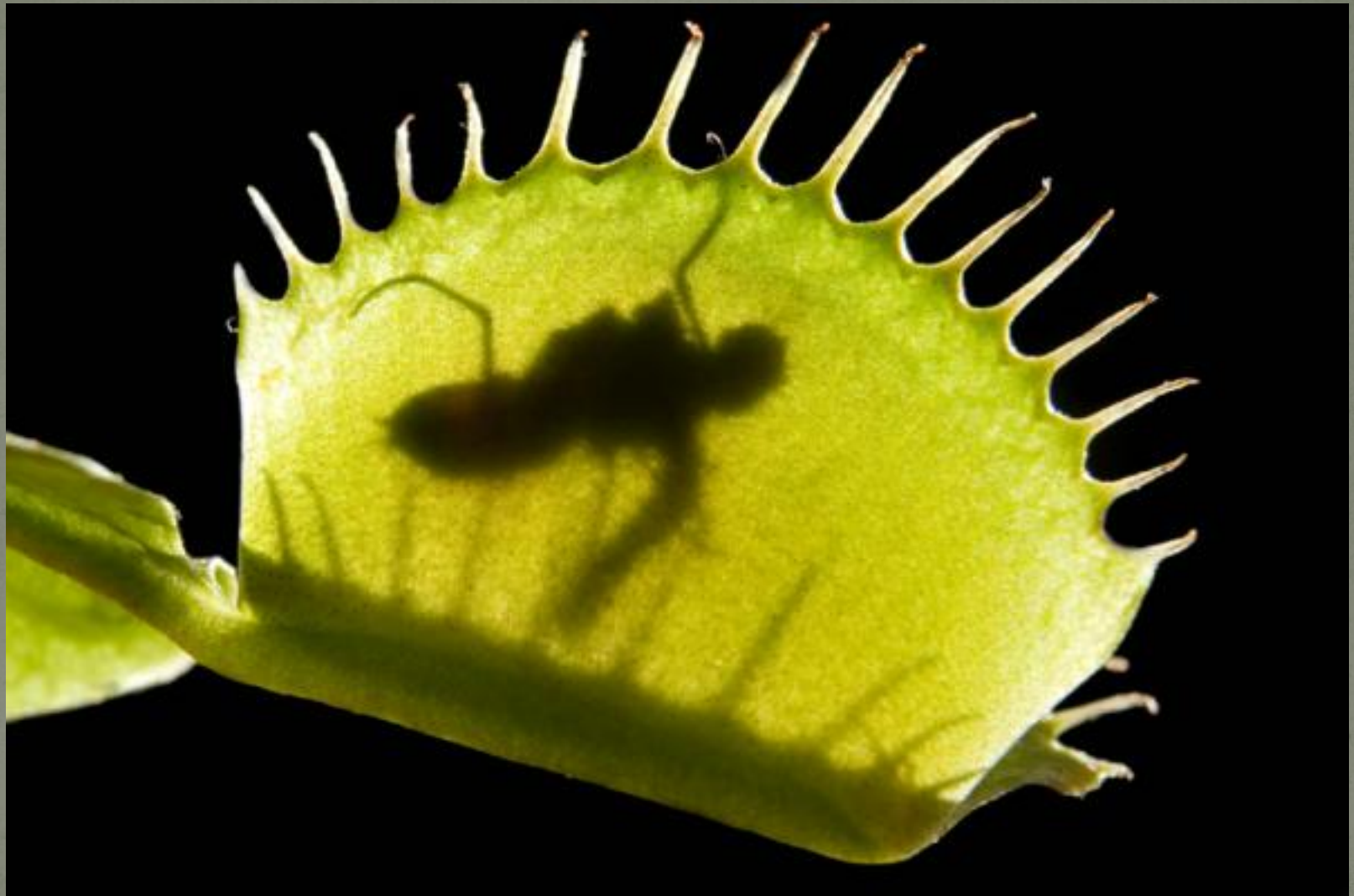
Origin of *S. alata* bacteria?

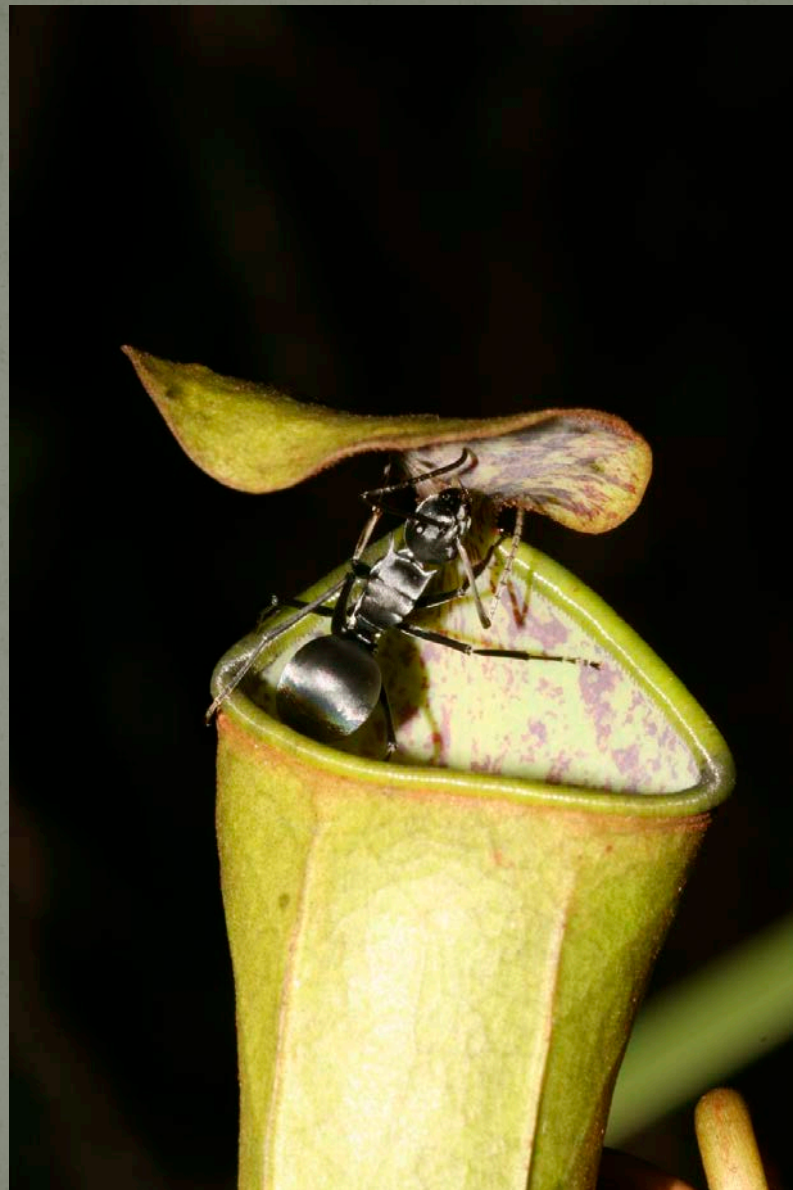


Arthropods associated with *S. alata*









Key things to remember

- all plants make energy from sunlight and CO₂
- plants compete for sunlight with other plants, but require nutrients (N & P) to grow tall
- plants are important parts of food chains (usually because they are food for herbivores)
- some plants live in places with poor nutrient availability – and get their nutrients by eating bugs

Key things to remember

- carnivory in plants has evolved at least 5 independent times
- there are several ways to be a carnivorous plant: sticky traps, snaptraps, pitcher traps
- the digestive microbiome in *Sarracenia alata* is very similar to that found in the microbiomes of the ants that *S. alata* eats
- suggests that the plant is evolving carnivory by 'borrowing' the microbiome of its prey species

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