

Natural Sciences 360

Legacy of Life

Lecture 4

Dr. Stuart S. Sumida

Science, Cells and Food

From Cells to Ecosystems

What is...

...Science?

Scientific Method:

1. Inquiry: Ask a question.
2. Observation: Gather data.
3. Hypothesis: Devise a model to explain the data.
4. TEST the hypothesis. (A hypothesis is valuable only if testable.) In other words, conduct an experiment.
5. If subsequent data support the hypothesis, it is strengthened.
6. If subsequent data do not support the hypothesis, the hypothesis must be reconsidered.

Heterotrophy versus Autotrophy

Heterotroph – an organism that must acquire its food (cannot make its own food)

Autotroph – an organism that can make its own food (plants that photosynthesize are the most common example)

Types of Autotrophy

Photoautotroph – an organism that uses the energy of sunlight to fix raw materials into energy rich compounds

Chemoautotroph – an organism that uses the energy of environmentally available chemical reactions to fix raw materials into energy rich compounds

Chemoautotrophs

Hydrothermal vent



Hydrothermal vent community supported by chemoautotrophic bacteria



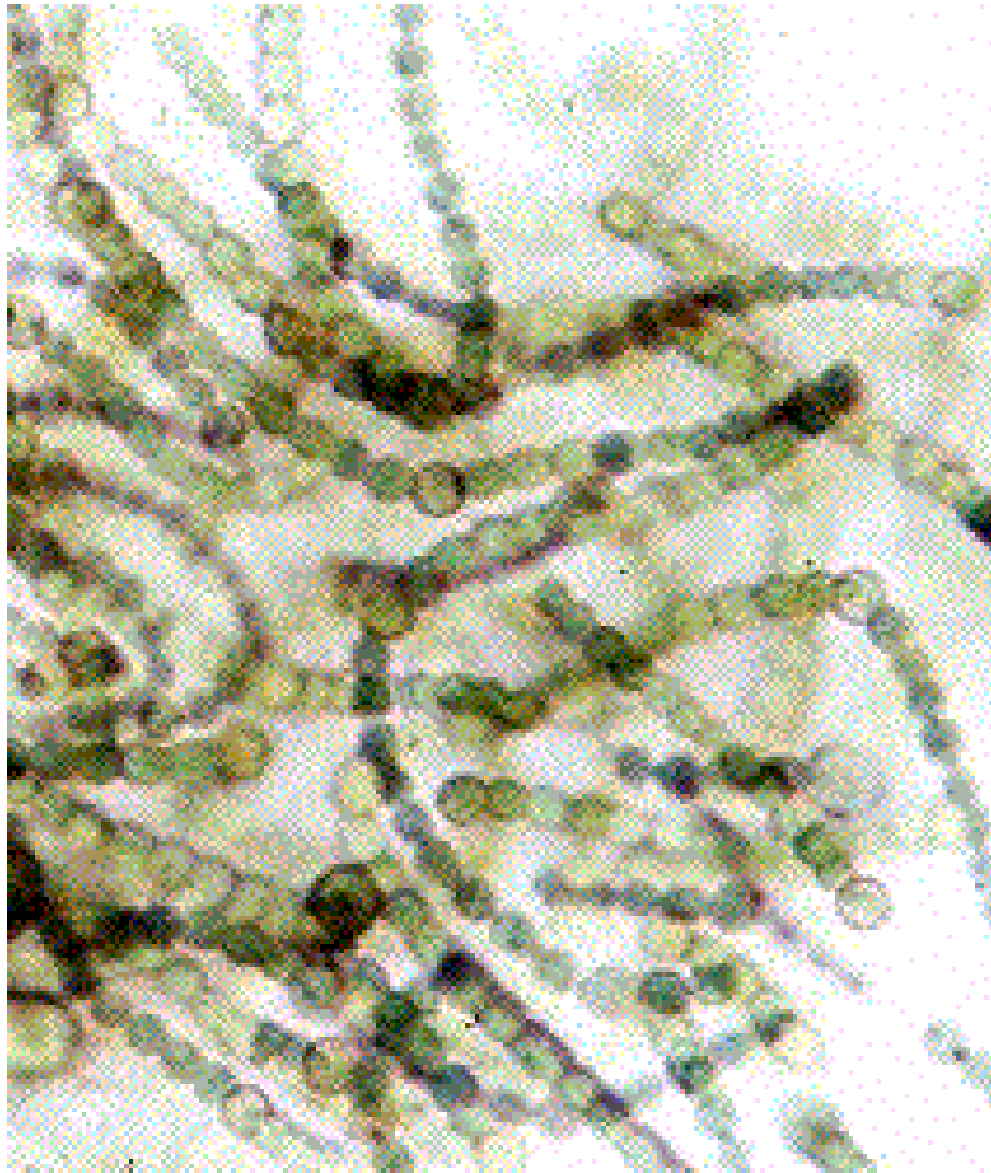
Hydrothermal vent community supported by chemoautotrophic bacteria



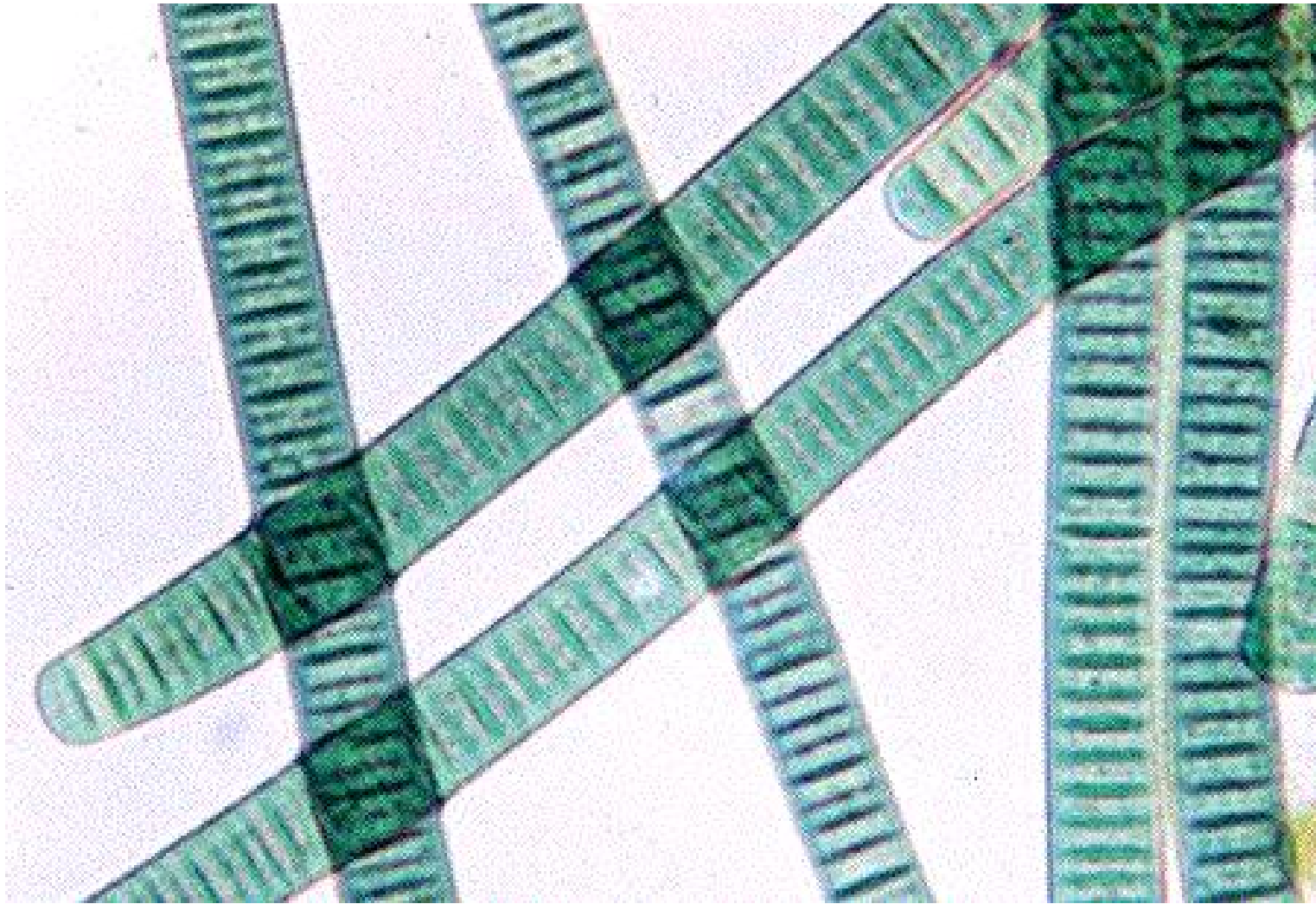
Hydrothermal vent community supported by chemoautotrophic bacteria



Photoautotrophs



Cyanobacteria, a group of bacterial photoautotrophs



Cyanobacteria, a group of bacterial photoautotrophs



Cyanobacteria, a group of bacterial photoautotrophs



Cyanobacteria, a group of bacterial photoautotrophs

It's important to note that simple cells like cyanobacteria were incorporated into other cells and ultimately became chloroplasts, the photosynthesizing organelles of more advanced plant-like organisms.

The incorporation of cells to become functioning organelles (subunits) of more complex cells is known as **ENDOSYMBIOSIS**.



Ferns, an example of a primitive multicellular, terrestrial photoautotroph



Horsetails, an example of a primitive multicellular, terrestrial photoautotroph



Flowering seed plants: more advanced photoautotrophs



Flowering seed plants: more advanced photoautotrophs

Heterotrophs

FUNGI are heterotrophs.

Fungi are NOT plants. They are heterotrophs. They don't ingest their food. They digest it outside their body and then absorb it.



Lichens

A symbiotic relationship between a green alga (a photoautotroph) and a fungus (a heterotroph).

The true identity of lichens as symbiotic associations of two different organisms was first proposed by Beatrix Potter, who is best remembered for her children's books about Peter Rabbit. In addition to her books, she spent time studying and drawing lichens. Her illustrations are still appreciated for their detailed and accurate portrayal of the delicate beauty of these bizarre organisms.



Lichen
growing on
a Juniper
tree



This lichen was valued as fiber in traditional cultures in the Northwest. It was used as bandages, baby diapers, feminine hygiene supplies, and even as raw material for ponchos and footwear (Lillooet). It made good artificial hair for decorating dance masks.

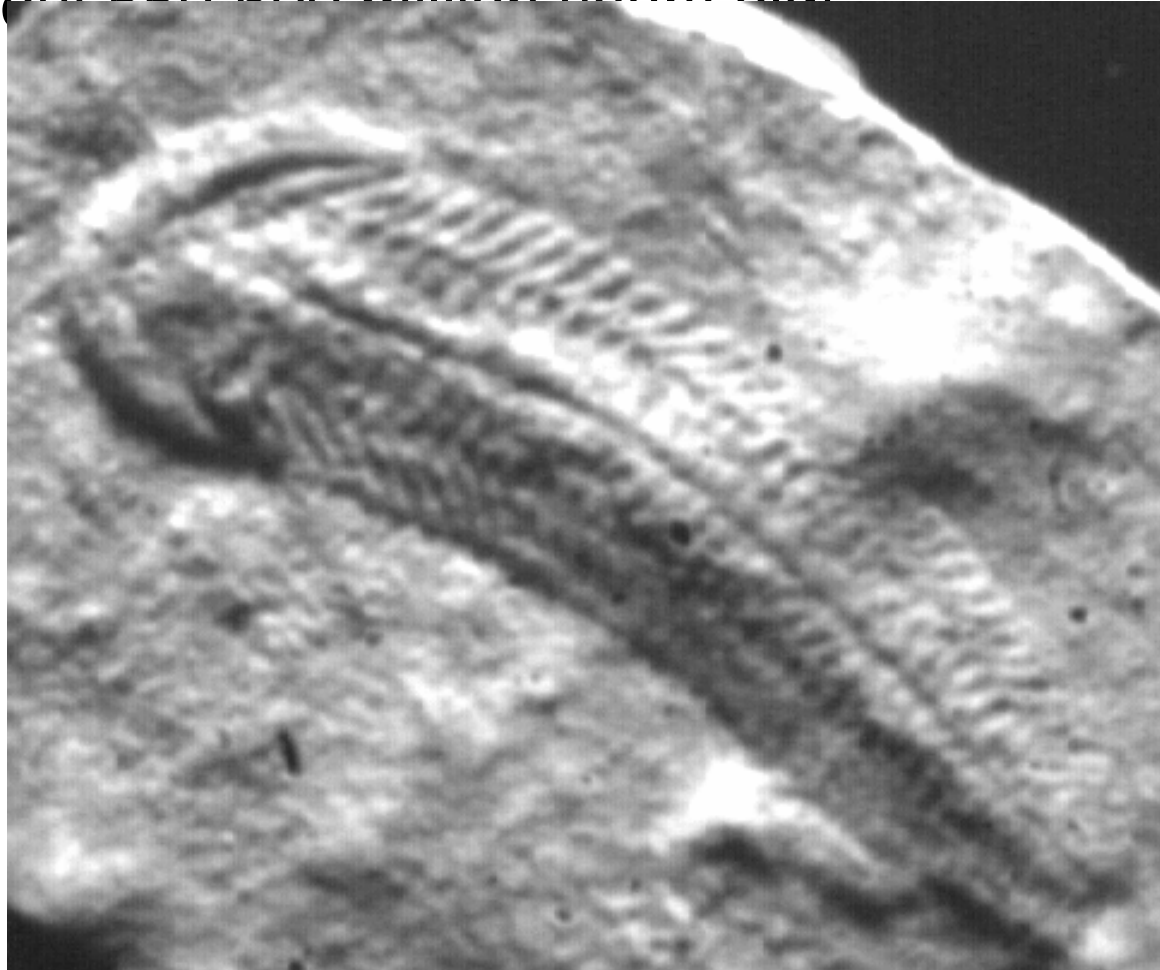
The lichen "Witch's hair" (*Alectoria sarmentosa*)

Some of the earliest known assemblages of multicellular heterotrophic animals from what are known as “Ediacarian faunas.” About 550-600 million years old!



Dickinsonia

Some of the earliest known assemblages of multicellular heterotrophic animals from what are known as “Ediacarian faunas.” About 550-600 million years old.



Spriggina

Some of the earliest known assemblages of multicellular heterotrophic animals from what are known as “Ediacarian faunas.” About 550-600 million years old!

Pteridinium



Herbivore – organism that eats plants and plant material exclusively

Carnivore – organism that eats animals and animal material (meat) exclusively

Omnivore – Dr. Sumida

Herbivore – organism that eats plants and plant material exclusively

Carnivore – organism that eats animals and animal material (meat) exclusively

Omnivore – organism that eats variety of foods, including both plant and animal derived materials.



Example of a strict herbivore



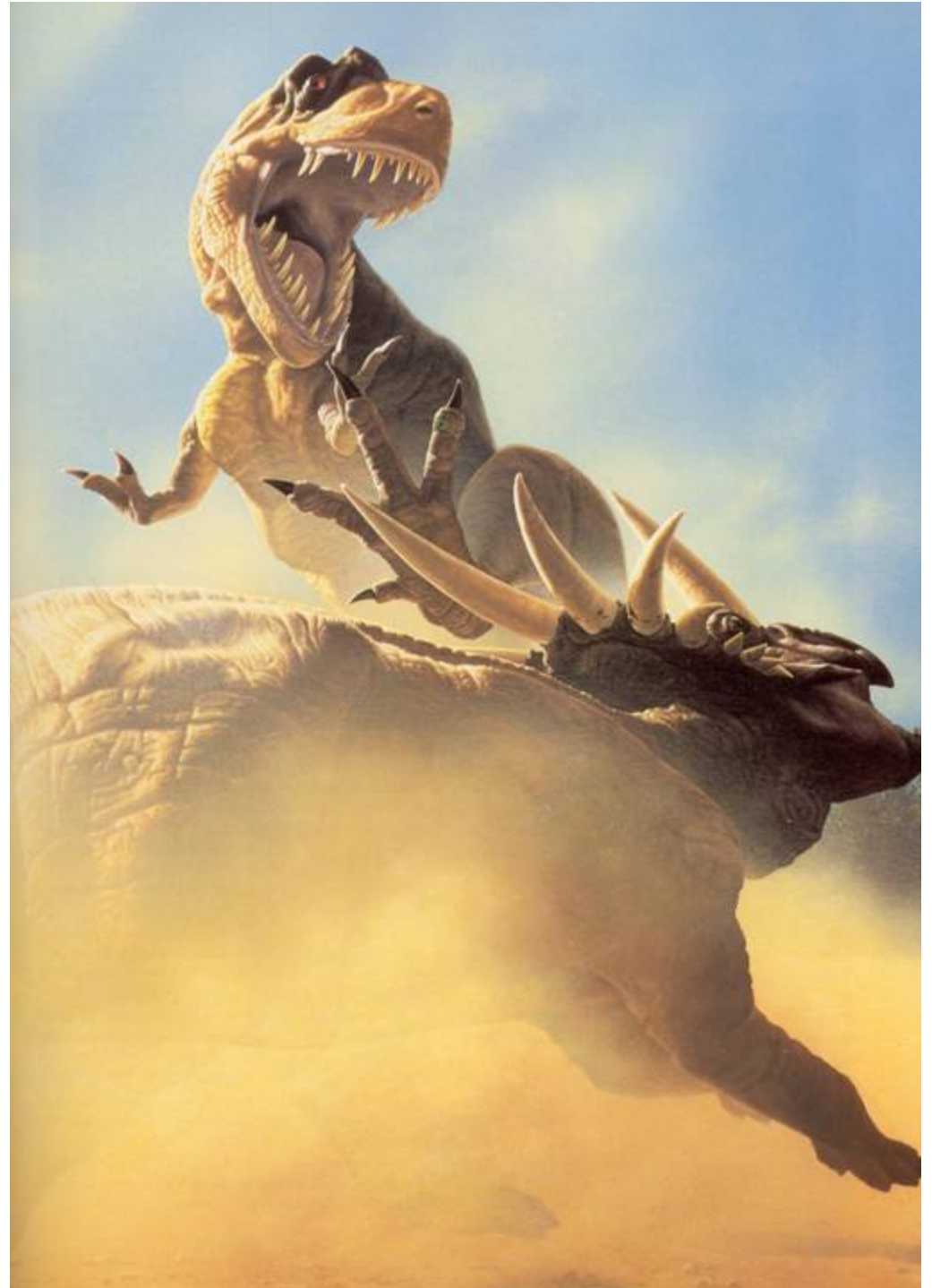
San Pedro River in 1984, from the Hereford bridge, before the removal of cattle in 1988.



1998 photo from same location, after 10 years of rest from livestock grazing.

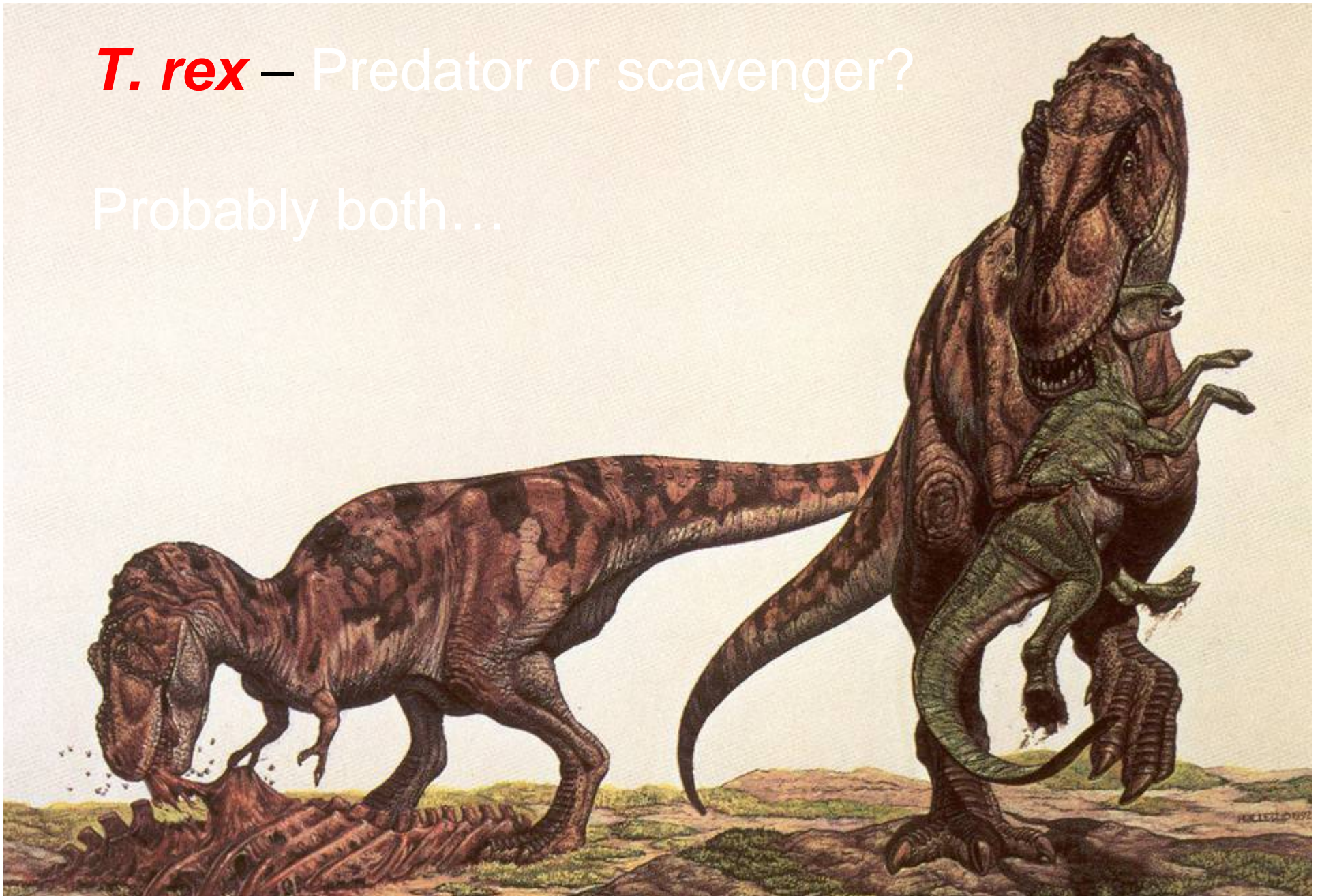
Daspletosaurus
A carnivorous
relative of
T. rex

Styracosaurus
An herbivorous
relative of
Triceratops



T. rex – Predator or scavenger?

Probably both...





How fast could **T. rex** really run?

Could it run 25 miles per hour?
40?

For ***T. rex*** to be able to travel at 20 m.p.h. the amount of leg muscle mass required to generate that much force would be about 95% to 110% its total body mass. Clearly impossible.

If legs are allowed to account for 40-50% of body mass (very generous), a conservative estimate for “cruising speed” is **11 miles per hour**. Quick burst would have been 15 miles per hour at most.

So what did the syllabus mean by:
“What does an animal and a martini have in common?”

What is an
“Ecosystem?”

Ecosystem – Community of organisms, interacting with one another, plus the environment in which they live, and with which they also interact.



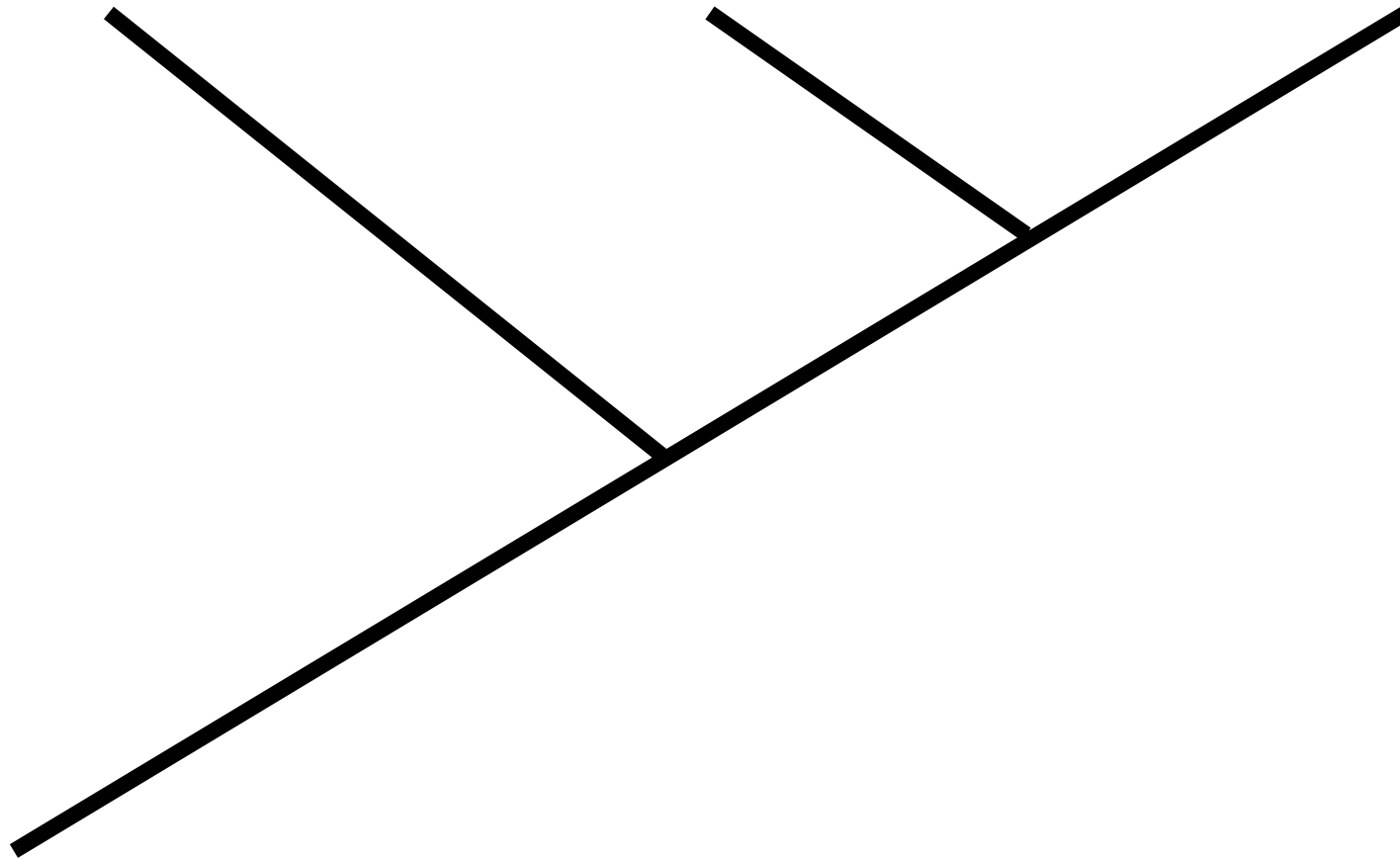
The human body
can also be
considered an
ecosystem...

Recall this diagram. Let's digress a bit

Bacteria

Archaea

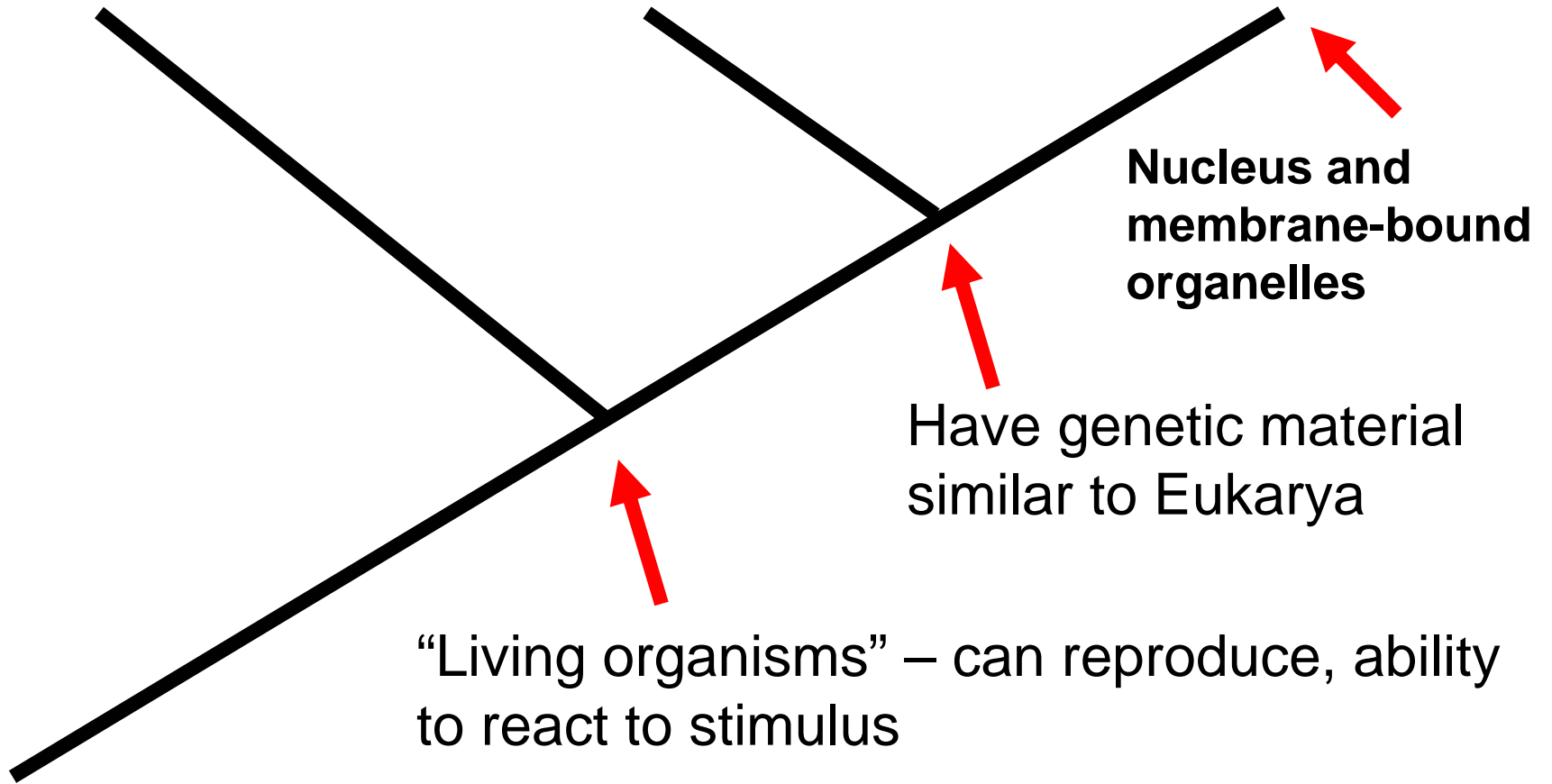
Eucarya



Bacteria

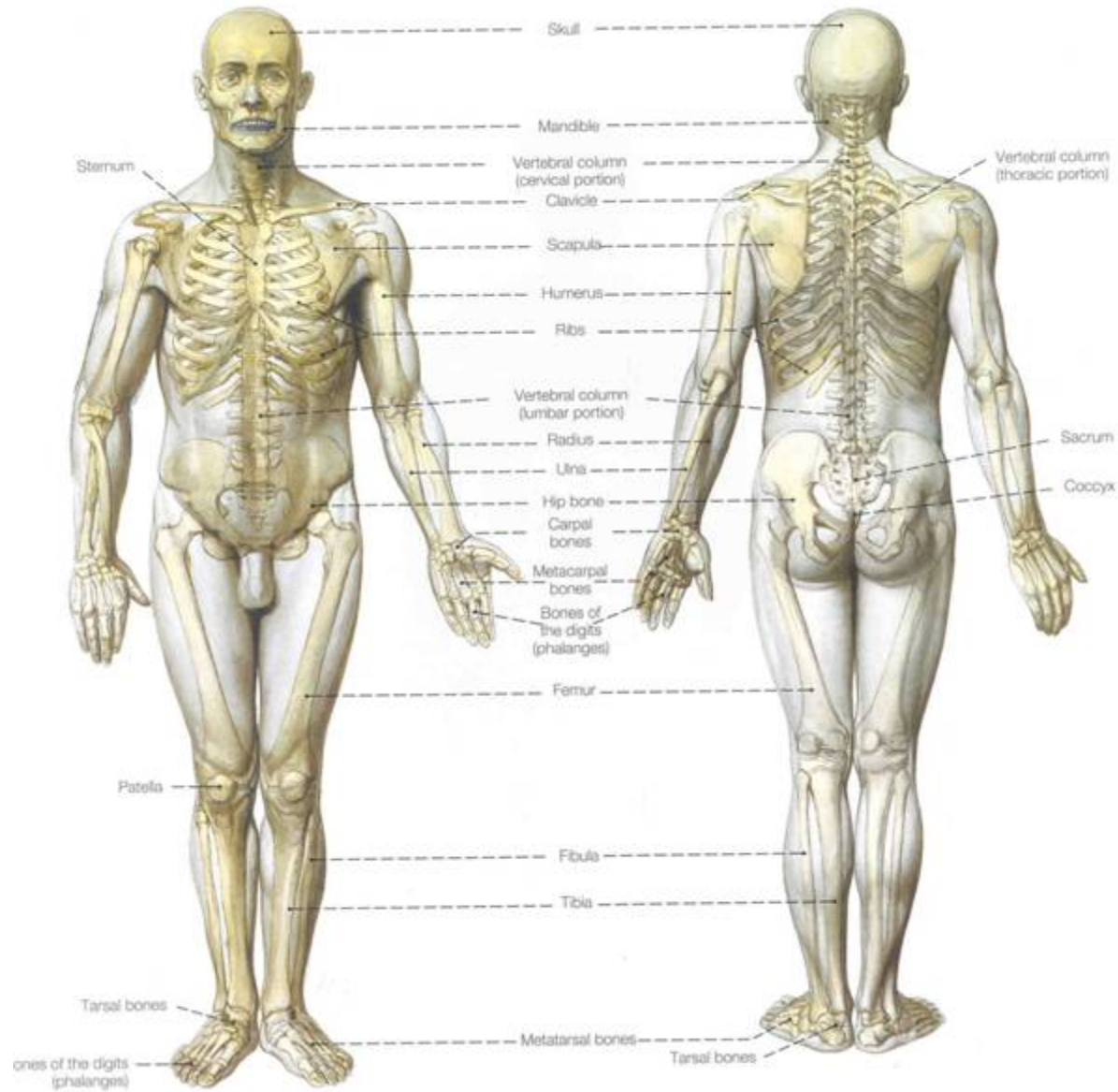
Archaea

Eucarya



Bacteria are organisms with no membrane-bound nucleus. They are simple, but important organisms.

Humans are eucaryotes,



but...