Objective:
The objective of this lab is to introduce you to the various means and methods by which an organism can become fossilized and train you to extract as much information as possible from a single fossil specimen.

Introduction:
The study of fossils and prehistoric life is called paleontology. Scientists study fossils not only to piece together a complete picture of everything that lived on the earth, but also to reconstruct the environments and ecosystems in which these organisms lived and died, thus helping to reconstruct a more complete picture of Earth’s history. The process of forming a fossil is called taphonomy, which includes all the processes that contribute to the final fossil, from the death of the organism to alterations before and after burial. There are numerous methods by which an organism can become fossilized. Some methods preserve more detail and original material than others. In some instances we may have the entire organism intact, while in others we may only have the faintest impression of the organism. Obviously, the more of the original organism that is present, the better we will be able to identify and understand the systematics of the organism. Additionally, by understanding how an organism became a fossil, we can identify the environment in which the organism died, thus unlocking clues to where it may have lived.

This weeks and next weeks labs represent a series of two fossil labs. In this first lab we will focus on understanding and identifying the different methods of fossilization. In the process, we will try to extract as much information as possible from each fossil sample. In next weeks lab we will focus more on the actual identification of the fossils by phylum, class and order.
Taphonomy:
The process by which an organism becomes a fossil is termed taphonomy. This includes any circumstances or alterations that the organism is subject to from its death, burial, decomposition, or post-burial alterations. Only a very small fraction of all organisms are successfully fossilized. Most organisms decompose or are eaten shortly after they die and therefore are never fossilized. In order for an organism to fossilize, it must be removed from environments or situations in which it will be eaten or in which it will decompose. The best way to remove an organism from threat of being eaten after death is a rapid burial or placement in a location that prohibits scavengers from access. This could result from burial under a landslide or debris flow, or within a tar pit or very harsh environment (frozen glacier, desert, etc.). Marine organisms are much more likely to be fossilized than are terrestrial organism due to the fact that most regions below sea-level are accumulating sediments whereas most terrestrial environments are prone to erosion. The three most important factors determining if an organism will fossilize is exposure to heat, water and oxygen. Post-death decomposition occurs fastest in warm, moist environments with plenty of oxygen. If any or all of these conditions are removed, decomposition will slow or cease. Such environments include cold deserts (little water), swamps (little oxygen), or ice (little water) among others.

Types of Fossilization:
Fossil can be broadly separated into two categories: body fossils and trace fossils. Body fossils exhibit the shape of the body of the original organism. Trace fossils only provide evidence of a portion of the organism or result from an action of the organism.

Below is a list of different methods of fossilizing an organism. The list begins with the most complete and detailed means fossilization and proceeds to less detailed means of fossilization.

**Unaltered Body Fossils** – complete body of organism is intact with all original hard parts, soft parts and chemical composition

**Altered Body Fossils** – complete body of organism is intact but all parts have been altered from their original chemical composition

- **Recrystallization** – conversion of aragonite to calcite
- **Replacement** – replacement of hard parts with another substance
- **Permineralization** – preservation if void spaces

**Molds and Casts** – rough imprints (molds) and reproductions (casts) of an organism

- **Carbonization** – outline of organism in carbon residue

**Trace Fossils** – any identifiable mark left by a living organism

- **Tracks** – separate footprints
- **Trails** – a continuous “dragging” mark
- **Burrows** – a hole dug for means of a residence or passage
- **Coprolites** – preserved feces
Assignment:

Samples have been provided of the numerous types of fossilization. These include **unaltered body fossils, permineralization, recrystalization, replacement, molds, casts, trace fossils, and carbonization**. Use the provided sheets to describe at least one or two samples representing each of these types of fossilization. Fill in as much as you can for each fossil. You will not be able to fill in all the information for every sample. Pay close attention to what type of organisms are most susceptible to which method of fossilization. Ultimately, you should be able to make a reasonable argument for why any specific sample is preserved the way it is.

*Note: there are numerous books and texts in the lab that you can use to help you find the information you need to complete the descriptions of each fossil.*
Try to answer the following questions after you have completed your descriptions of samples:

1.) What do the fossils made of quartz/silica all have in common? Where do they live?

2.) What do the fossils made of calcite/limestone all have in common? Where do they live?

3.) Within what type of rock are carbonized fossils usually contained? What could possibly explain this? (In what environment was the rock deposited and how might this be linked to its preservation? Where would you expect to find lots of dying plants and how would that affect the depositional environment?)

4.) Within what type of rock are casts and mold usually contained? What could possibly explain this? (What was the original chemical composition of the organism that has left the mold or cast and how could we remove this from the depositional matrix? Why did we remove the original fossil but not remove the rock enclosing it?)

5.) Within what type rock are replaced fossils usually contained? What could possibly explain this? (Consider why these organism were not removed, similar to those in the previous question, but instead were preserved in detail)
Description of fossil:_____________________________________________________

Environment in which this organism lived: (ocean, land, shallow/deep water, warm/cold climate, etc)

Mineralogic composition of fossil:__________________________________________

Is this the original material (yes/no):_______________________________________  
If no:  
Original composition:_____________________________________________________

Lithology of matrix (if any is present):_______________________________________

Depositional environment of matrix lithology:________________________________

Type of fossilization:______________________________________________________

Description of fossil:_____________________________________________________

Environment in which this organism lived: (ocean, land, shallow/deep water, warm/cold climate, etc)

Mineralogic composition of fossil:__________________________________________

Is this the original material (yes/no):_______________________________________  
If no:  
Original composition:_____________________________________________________

Lithology of matrix (if any is present):_______________________________________

Depositional environment of matrix lithology:________________________________

Type of fossilization:______________________________________________________
Description of fossil: _______________________________________________________

Environment in which this organism lived: (ocean, land, shallow/deep water, warm/cold climate, etc) _______________________________________________________

Mineralogic composition of fossil: _______________________________________

Is this the original material (yes/no): ______________________________________

If no:

   Original composition: ______________________________________

Lithology of matrix (if any is present): ___________________________________

Depositional environment of matrix lithology: _____________________________

Type of fossilization: ____________________________________________
Description of fossil: _______________________________________________________

Environment in which this organism lived: (ocean, land, shallow/deep water, warm/cold climate, etc) _______________________________________________________

Mineralogic composition of fossil: __________________________________________

Is this the original material (yes/no): _________________________________________
   If no:                                                                
      Original composition: ____________________________________________

Lithology of matrix (if any is present): ______________________________________

Depositional environment of matrix lithology: _________________________________

Type of fossilization: _______________________________________________________

Description of fossil: _______________________________________________________

Environment in which this organism lived: (ocean, land, shallow/deep water, warm/cold climate, etc) _______________________________________________________

Mineralogic composition of fossil: __________________________________________

Is this the original material (yes/no): _________________________________________
   If no:                                                                
      Original composition: ____________________________________________

Lithology of matrix (if any is present): ______________________________________

Depositional environment of matrix lithology: _________________________________

Type of fossilization: _______________________________________________________

Description of fossil: _______________________________________________________

Environment in which this organism lived: (ocean, land, shallow/deep water, warm/cold climate, etc) _______________________________________________________

Mineralogic composition of fossil: __________________________________________

Is this the original material (yes/no): _______________________________________
If no:
   Original composition: ___________________________________________________

Lithology of matrix (if any is present): ______________________________________

Depositional environment of matrix lithology: _________________________________

Type of fossilization: ______________________________________________________

Description of fossil: ______________________________________________________

Environment in which this organism lived: (ocean, land, shallow/deep water, warm/cold climate, etc) _______________________________________________________

Mineralogic composition of fossil: __________________________________________

Is this the original material (yes/no): _______________________________________
If no:
   Original composition: ___________________________________________________

Lithology of matrix (if any is present): ______________________________________

Depositional environment of matrix lithology: _________________________________

Type of fossilization: ______________________________________________________
Description of fossil:_____________________________________________________

Environment in which this organism lived: (ocean, land, shallow/deep water, warm/cold climate, etc)_____________________________________________________

Mineralogic composition of fossil:__________________________________________

Is this the original material (yes/no):________________________________________
   If no:
      Original composition:____________________________________________________

Lithology of matrix (if any is present):______________________________________

Depositional environment of matrix lithology:______________________________

Type of fossilization:______________________________________________________
Description of fossil:_____________________________________________________

Environment in which this organism lived: (ocean, land, shallow/deep water, warm/cold climate, etc)

____________________________________________________________________

Mineralogic composition of fossil:________________________________________

Is this the original material (yes/no):____________________________________

If no:
   Original composition:__________________________________________________

Lithology of matrix (if any present):______________________________________

Depositional environment of matrix lithology:_______________________________

Type of fossilization:_____________________________________________________

Description of fossil:_____________________________________________________

Environment in which this organism lived: (ocean, land, shallow/deep water, warm/cold climate, etc)

____________________________________________________________________

Mineralogic composition of fossil:________________________________________

Is this the original material (yes/no):____________________________________

If no:
   Original composition:__________________________________________________

Lithology of matrix (if any present):______________________________________

Depositional environment of matrix lithology:_______________________________

Type of fossilization:_____________________________________________________