Name: _____

Lab 2
Geological Time and Fossil Samples

This lab has two components: understanding geological time scales and choosing fossil samples from the IU Paleontology Collection. You will learn to distinguish lithostratigraphic and chronostratigraphic geological charts, estimate rates of sedimentation, browse the paleontology collection to connect the scope of our holdings to the timescale, and choose a sample of fossils for your lab project.

Part A: Geological Timescales

Lithology is a rock classification scheme based on composition. Sandstones, siltstones, and limestones are all lithological classifications. A limestone can be found on any continent from any geological period since the origin of marine organisms.

Stratigraphy is a rock classification scheme based on time and place. Stratigraphy organizes rocks by time and makes correlations across space between contemporaneous rocks. Rocks, along with the fossils and chemicals in them, provide the evidence for Earth history, so the geological timescale by which we measure that history is closely tied to rocks.

Time is so closely tied to rocks that the two are easy to confuse. This exercise tries to make clear the distinction between chronostratigraphic and lithostratigraphic charts.

A *chronostratigraphic chart* shows units of time arranged from youngest to oldest. The timescale presented in the last lecture is an example of a chronostratigraphic chart, and the handout titled *International Stratigraphic Chart* is another. There are no gaps in time in these charts. The chart summarizes the names of geological time periods and provides the age of the boundaries between them. Such a chart is derived from correlations and dating of rocks from around the world.

A *lithostratigraphic chart* shows the units of rock that are actually found in a specific geographic region. The handout titled *Generalized Stratigraphic Column for Paleozoic Rocks of Indiana* is an example of a lithostratigraphic chart. The names of the rock units, their lithology and thickness, and the geological time period to which they belonged are summarized on such a chart. Local rock units seldom cover all of geological time, so a lithstratigraphic chart has gaps in time (called unconformities).

Rocks are stratigraphically classified into named *lithostratigraphic units*. The base unit is the *formation*, which is a layer of rock whose distribution can be mapped, whose composition is similar throughout its extent, and whose origin was associated with a particular depositional environment during a finite part of Earth's history. For example, the *Salem Formation* is the formal lithostratigraphic name given to the "Indiana limestone" that is quarried around Bloomington and

Bedford . It is composed of a fine-grained limestone that was deposited on a carbonate bank about 330 mya. The unit crops out in a north-south trending belt in the Mitchell Plateau physiographic region. You can find the Salem Fm. on the General Stratigraphic Column in the Valmeyeran Epoch of the Mississippian period. Formations are divided into *members*, which are thinner units within the formation that differ from one another in lithology. Often members are not geographically extensive and cannot be mapped as easily as the entire formation. Formations are grouped for convenience. The Salem Fm. belongs to the Sanders Group.

A lithostratigraphic chart shows the *superpositional relationships*, or "stacking order" of rocks in a region. The youngest rocks are shown at the top of the chart and the oldest at the bottom, with columns arranged youngest to oldest from left to right. In a large region like Indiana, all the rocks on the chart will never be found in one place. However, stratigraphic correlation allows them to be shown in order from youngest to oldest as if they were all stacked in the same cliff face. The boundaries between formations and groups may coincide with periods of erosion or non-deposition, which represent gaps in time or *unconformities*. Often these are symbolized by squiggly lines between the units,such as one sees between the Raccoon Creek and Buffalo Wallow group.

The handout titled *Regional Stratigraphy and Petroleum Systems of the Illinois Basin* is a hybrid between a lithostratigraphic and chronostratigraphic chart. The lithostratigraphy of Indiana is shown using a continuous chronostratigraphic scale. Unconformities are clearly shown as large gaps between the rock units. For example, in eastern Indiana there was a long period of non-deposition and erosion between 420 and 400 million years ago.

Assignment Part A:

1. For each of the geological Periods, calculate the maximum and minimum thickness of rocks in Indiana. Units vary spatially in their thickness which is why there is not a single answer to how thick the rocks are.

Period	Min Thickness (m)	Max thickness (m)
Pennsylvanian		
Mississippian		
Devonian		
Silurian		
Ordovician		
Cambrian		

2. For each of the geological Periods, estimate the total duration in millions of years of the rocks themselves. Remember unconformities: the Mississippian aged rocks in Indiana do not represent the entire Mississippian Period. Use the *Regional Stratigraphy* chart for these calculations.

	Western Indiana			Eastern Indiana		
Period	Min age	Max age	Duration	Min age	Max age	Duration
Pennsylvanian						
Mississippian						
Devonian						
Silurian						
Ordovician						
Cambrian						

3. Estimate the overall rate of deposition (meters per million years) for each period by dividing the thickness of sediment by the amount of geological time.

	Western Indiana		Eastern Indiana	
Period	Min rate	Max rate	Min age	Max age
Pennsylvanian				
Mississippian				
Devonian				
Silurian				
Ordovician				
Cambrian				

4. To what extent do the thickness of sediments and the rates correlate? When was sediment deposition greatest? When the least? Make some hypotheses why.

Part B: IU Paleontological Collection

The *IU Paleontology Collection* is a scientific research collection belonging to the Department of Geological Sciences. It holds approximately 1.3 million fossil specimens to meet the research, teaching, and outreach missions of the Geological Sciences Department and the University. Most of the fossils are marine invertebrates from the Paleozoic Era (253–542 million years ago) of North America, but the Collection also contains material from other geological time periods from around the world, including plant and vertebrate fossils. The specimens in the Collection represent the results of field projects and excavations by IU faculty, students, and associates. They serve as documentation of the results published in scientific papers and can be used by other scientists to verify those results. They also serve as the basis for new research projects. The historically oldest material was collected by David Dale Owen's 1839–1852 Congressionally mandated survey of Wisconsin, Iowa, and Minnesota, and material that results from ongoing research is regularly accessioned into the Collection today. The Collection also houses fossils collected from US Federal lands, which are legally US property that are permanently housed at IU. Smaller collections of minerals, some of them precious, clay samples, and sedimentary rock samples are also part of the teaching and research holdings of the Department. The Collection is open to researchers by request to the curators (Drs. C. Johnson, Polly, and Njau). Specimens may be borrowed by researchers at established institutions with formal permission of the curators.

Assignment Part B:

In this part of the lab we will visit the main ranges of the IU Paleontology Collection in the basement of the Geology Building. We will survey the holdings and choose samples for class projects. You will take these samples carefully to GY 518 to store there for the duration of the semester. We will make use of those samples during upcoming labs.

When specimens are removed from the Collection, ***removal cards must be placed in the drawers*** indicating who borrowed them, for what purpose, and when they will be returned. The cards should also indicate what material was removed. Do not remove material until Dr Polly has okayed your sample.

1. Count the number of cases of fossils in the Collection for each of the geological periods

Period	Cases	Period	Cases
Neogene		Mississippian	
Paleogene		Devonian	
Cretaceous		Silurian	
Jurassic		Ordovician	
Triassic		Cambrian	
Permian			
Pennsylvanian			

2. Dr Polly will assign you a time Period. CAREFULLY look through some of the cases for your Period. Identify a sample to work with using the following criteria:

    a. Sample has labels that indicate the rock unit and location
    b. Sample has a variety of fossil types
    c. Sample is small enough to fit in a single drawer

Once you have identified a suitable sample, LEAVE IT IN PLACE and have Dr. Polly ok it. Then record the following information here:

Period: _____

Rock Unit: _____

Location: _____

Number of boxes or trays: _____

Approximate number of fossils: _____

Case label: _____

Drawer number: _____

Other labels (e.g., "Ausich Dissertation"):

Then record the same information along with your name and date on the following two pages. Remove the material, tear off the one page and leave it in the drawer as a place holder.

It is critical that we not lose the information and labels that allow us to get the specimens back into their proper place in the collection at the end of the semester.

Carefully transport your specimens to the lab (GY 518), where we will store them in the Geology G308 cabinet. Tear off the other page and place it in the cabinet with your specimens.

MATERIAL REMOVED FOR GEOLOGY G308 LAB PROJECT

Jan 18 – May 1, 2013
Material stored in GY 518

Student Name: _____

Period: _____

Rock Unit: _____

Location: _____

Number of boxes or trays: _____

Approximate number of fossils: _____

Case label: _____

Drawer number: _____

Other labels or information (e.g., “Ausich Dissertation”):

MATERIAL REMOVED FOR GEOLOGY G308 LAB PROJECT

Jan 18 – May 1, 2013
Material stored in GY 518

Student Name: _____

Period: _____

Rock Unit: _____

Location: _____

Number of boxes or trays: _____

Approximate number of fossils: _____

Case label: _____

Drawer number: _____

Other labels (e.g., “Ausich Dissertation”):