"People of the Waters" Exhibit

Oshkosh Public Museum

Oshkosh, Wisconsin

High School Curriculum

November, 2017

1331 Algoma Blvd, Oshkosh, WI 54901
920.236.5799 · oshkoshmuseum.org

Lesson Plan for People of the Waters Exhibit: Journey through Time
Interactive Glacier Map

Lesson Name: **Natural Architects**

Grade: **High School**

Subject Area(s): **Social Studies, Science**

Objectives: Wisconsin has one of the most diverse topography in the Great Lakes Region because of the paths taken by the last glacier as can be seen in the *People of the Waters* interactive glacier map display. Students will learn the history of the Ice Age in Wisconsin with a focus on the glacier known as the "Laurentide Sheet" and its features such as glacial lobes. Students will learn how glaciers form and effected the topography. Students will be able to demonstrate and understand the processes associated with glaciation in a hands-on glacier activity.

Standards Addressed:

- Social Studies
  - Geography: A.12.1, A.12.3
  - History: B.12.3
- Science
  - Nature of Science: B.12.5
  - Science Inquiry: C.12.2, C.12.5
  - Science, Earth, and Space: E.12.2

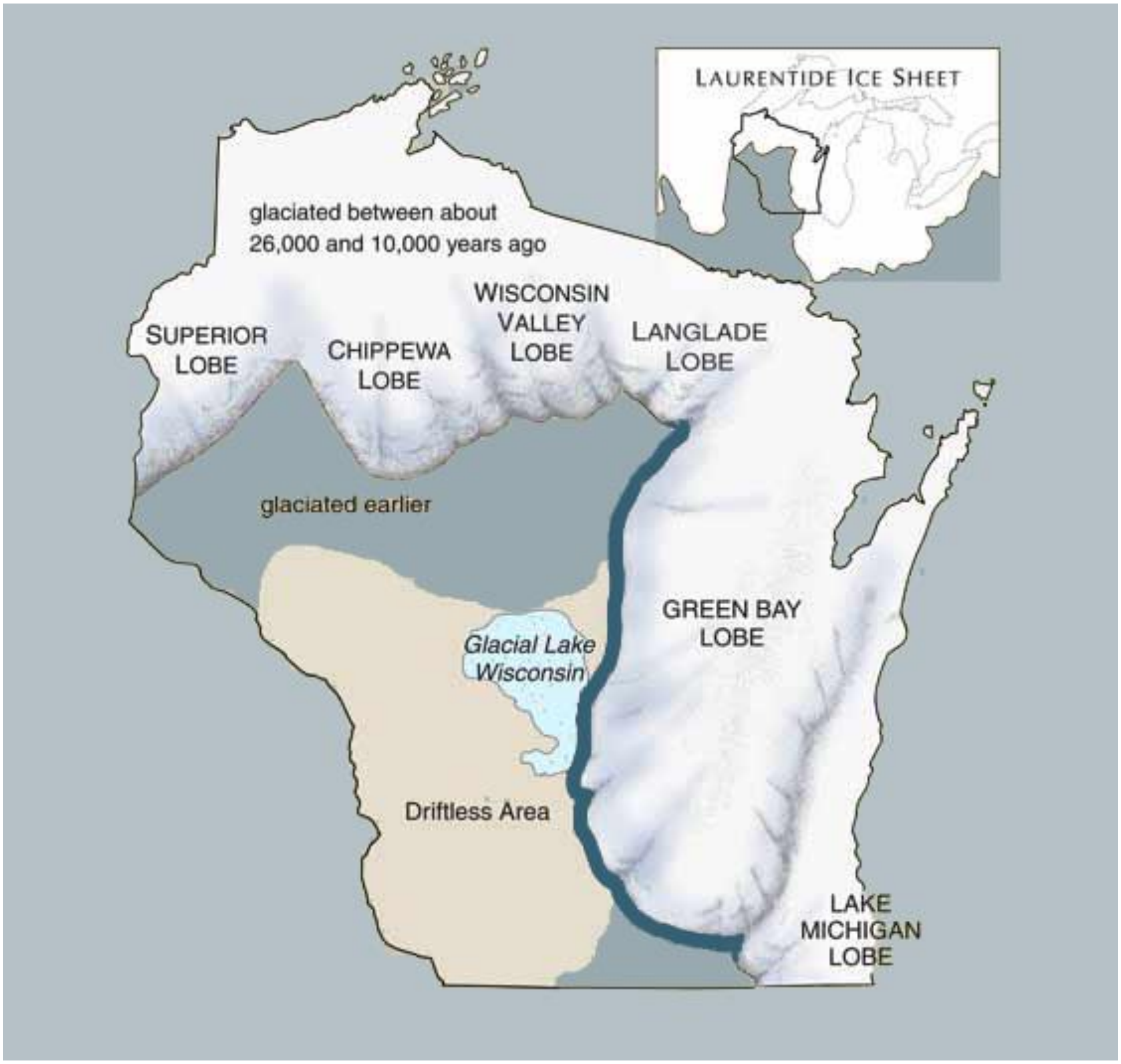
Materials:

- Publication: *Wisconsin Geological and Natural History Survey: Glaciation of Wisconsin*
- Blank Map of Laurentide Sheet (for students to fill in "lobes") and Teacher Key Map
- "Natural Architects" Lab Activity

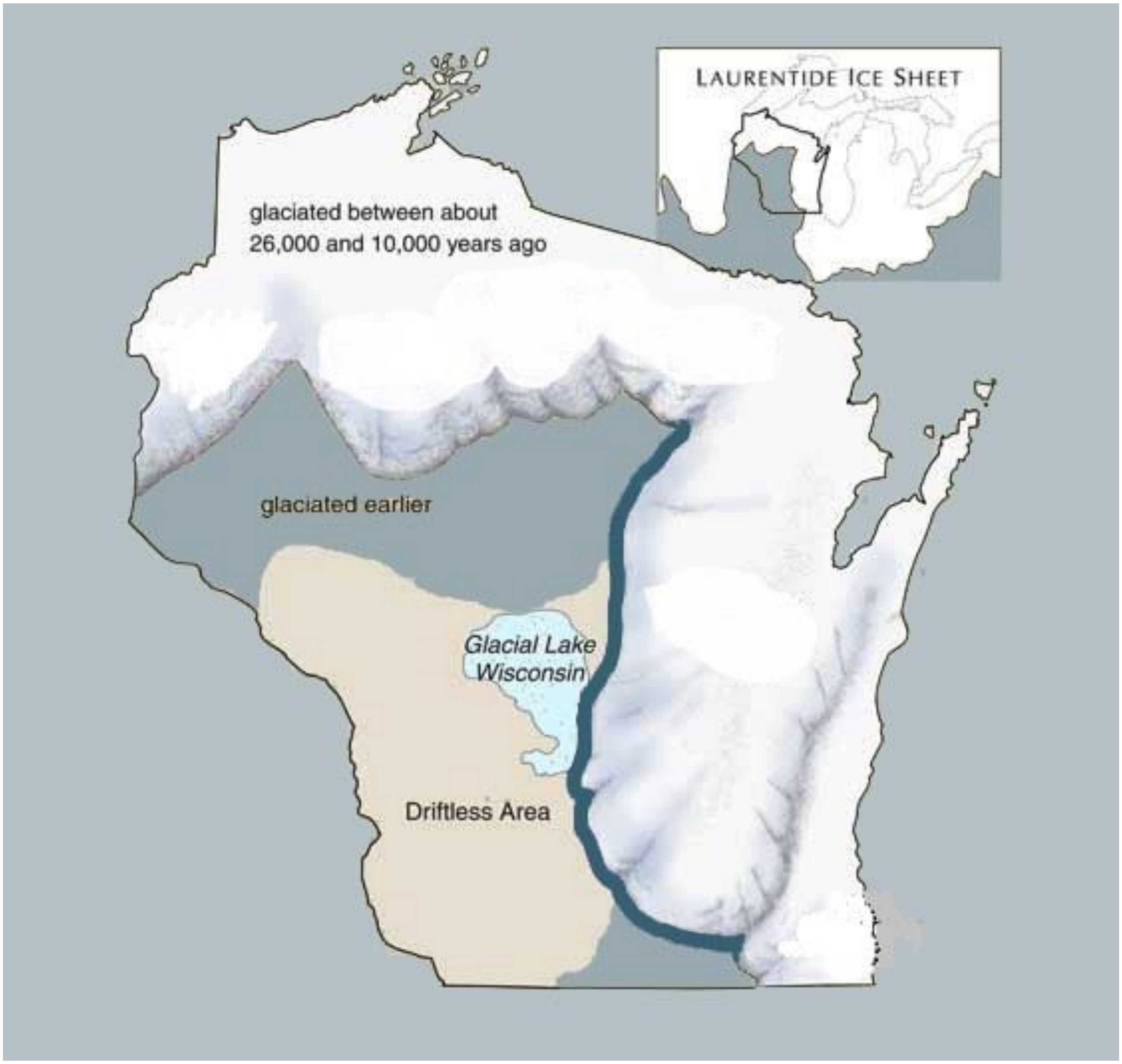
Activity:

1. Each student will read about Wisconsin Glaciation using the publication *Wisconsin Geological and Natural History Survey: Glaciation of Wisconsin* and will fill in the various glacier lobes on the fill in Laurentide Ice Sheet Map.
2. To understand how glaciers shaped the landscape of Wisconsin, they will participate in a hands-on glacier activity.

Map of Laurentide Ice Sheet (glacier lobes filled in)



Map of Laurentide Ice Sheet (Fill In)



Natural Architects
Modified from the National Park Service and University of Colorado: *Glaciers: An educational curriculum guide on glacier resources*.

Part 1/Day 1: Lab Activity Set-up

Procedure
Students work in pairs or small groups to set up a lab activity that will be completed the following school day. The teacher should model the lab set-up procedure as the students follow the lab preparation directions.

Materials

- Paper plate
- Paper cups
- Tap water
- Gravel or course sand
- Plastic wrap
- Tape

Lab Activity Preparation

1. Fill ½ your cup with gravel or sand.
2. Fill the cup with water until there is about an inch of water over the rocks.
3. Securely tape plastic wrap over the top of the cup.
4. Flip the cup onto the paper plate.
5. Write your group's name on the paper plate.
6. Leave the inverted cup (on the plate) in a freezer overnight

Part 2/Day 2: Lab Activity

Purpose: This activity will demonstrate the processes associated with glaciation.

Materials

- Pre-made “glacier”
- Paper towels
- Unglazed brick or flat paving brick
- Flat limestone rock
- Smooth piece of wood
- Protective or plastic gloves

Procedure

1. Get the glacier that your group made.
2. Unwrap the plastic wrap and peel off the paper cup
3. Once you have put your gloves on, perform the following steps for the brick, the wood, and the rock.
    a. With the gravel side down, scrape your glacier across your object.
        i. To simulate the movement of a glacier, you should only scrape in one direction.
        ii. It may be necessary to scrape in the same direction a number of times before you get any results.
    b. Draw any patterns on the following table.

Patterns		
Wood	**Brick**	**Rock**

    c. Record your observations in the Observations table below.
        i. Was the surface of your object or glacier scratched?
        ii. Was any material removed from your object or glacier?

Name:

Observations		
Wood	**Brick**	**Rock**

Results:

1. What happened when you scraped the glacier against the wood?

2. What happened when you scraped the glacier against the rock?

3. What happened when you scraped the glacier against the brick?

Making a Connection:

1. What can you infer about the way that real glaciers affect the landforms over which they move?

2. If evidence of glacial scouring is found in an area that is too warm for glaciers to exist, what can you infer about the past climate of that area?

Glaciation of Wisconsin

Educational Series 36 | 2011
Fourth edition

For the past 2.5 million years, Earth's climate has fluctuated between conditions of warm and cold. These cycles are the result of changes in the shape of the Earth's orbit and the tilt of the Earth's axis. The colder periods allowed the growth of glaciers that covered large parts of the world's high altitude and high latitude areas.

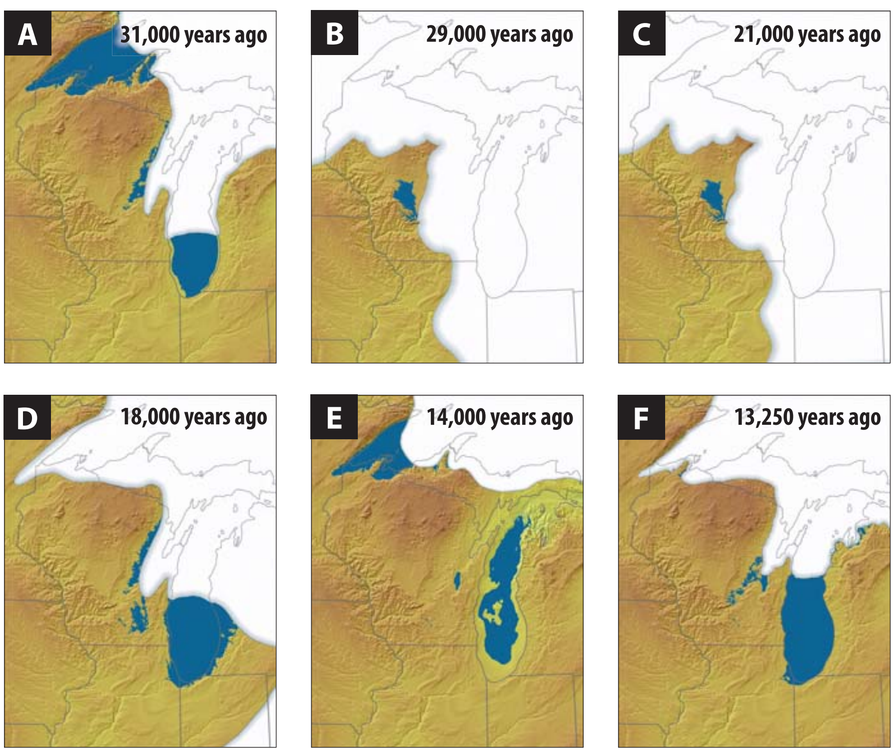
The last cycle of climate cooling and glacier expansion in North America is known as the Wisconsin Glaciation. About 100,000 years ago, the climate cooled and a glacier, the Laurentide Ice Sheet, began to cover northern North America. For the first 70,000 years the ice sheet expanded and contracted but did not enter what is now Wisconsin.

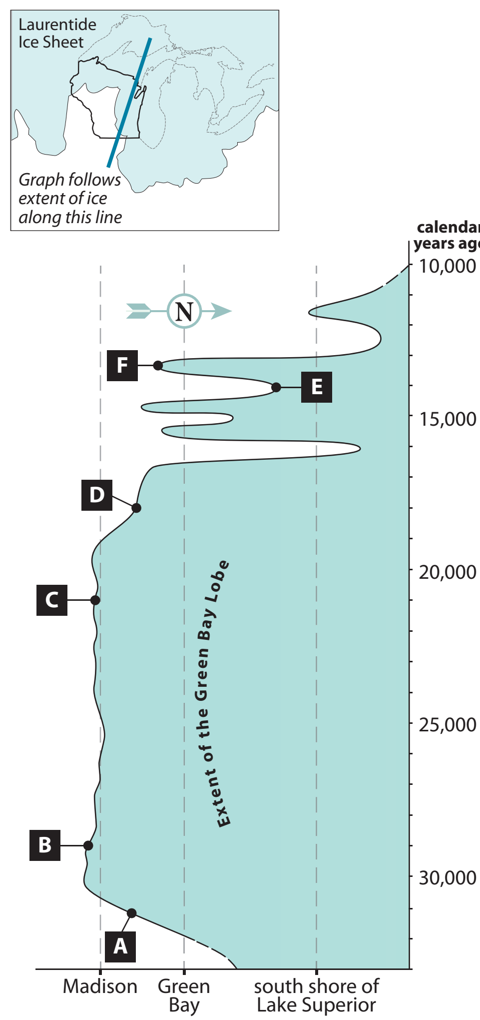
During the last part of the Wisconsin Glaciation, the Laurentide Ice Sheet expanded southward into the Midwest as far as Indiana, Illinois, and Iowa. The ice sheet advanced to its maximum extent by about 30,000 years ago and didn't melt back until thousands of years later. It readvanced a number of times before finally disappearing from Wisconsin about 11,000 years ago. Many of the state's most prominent landscape features were formed during the last part of the Wisconsin Glaciation.

The maps and diagrams in this publication show the timing and location of major ice-margin positions as well as the distribution of the glacial and related stratigraphic units that were deposited in Wisconsin.

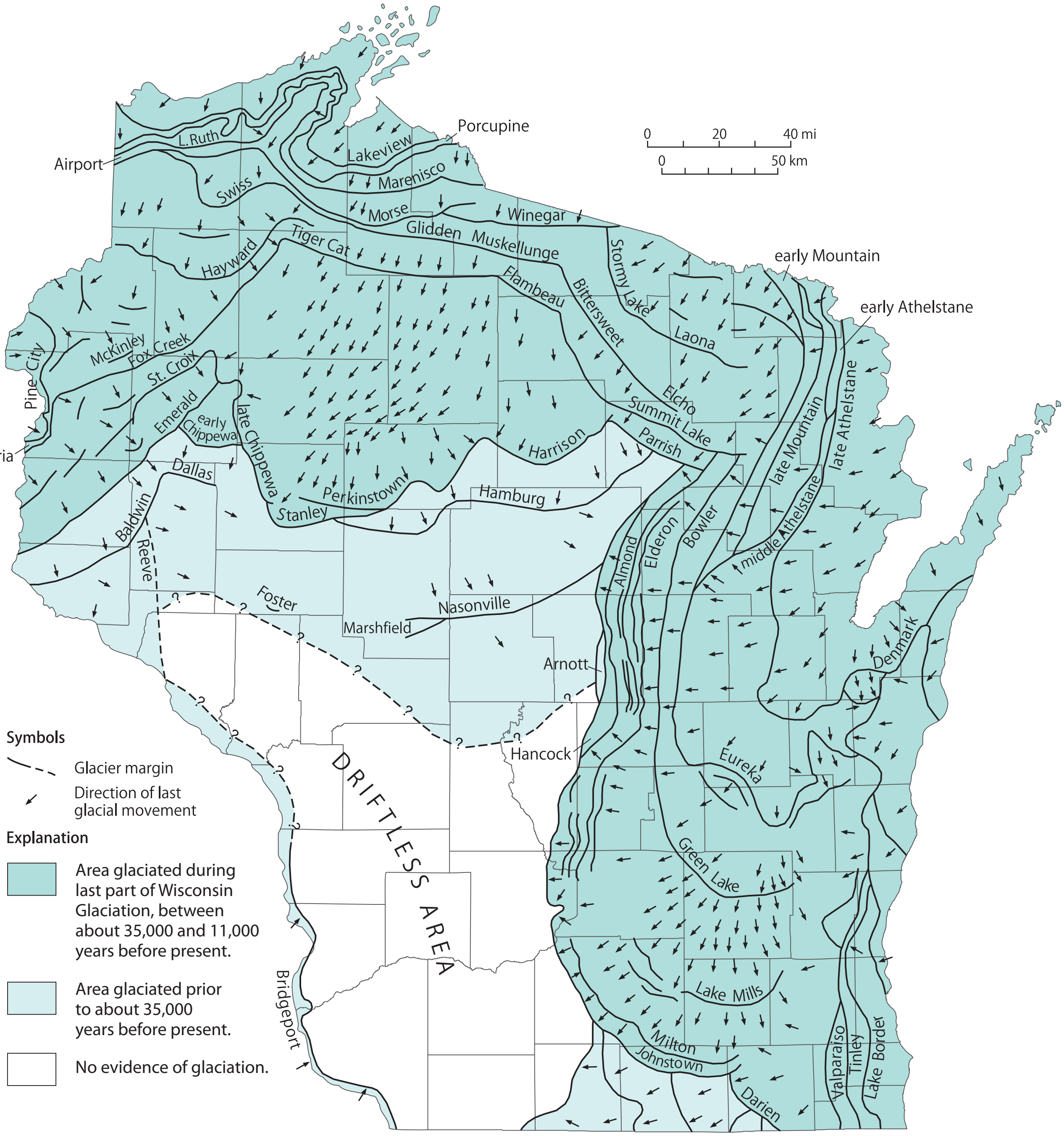
Tracking the glacier

Maps showing the extent of the Laurentide Ice Sheet and changes to glacial lakes at several times. This set of maps, keyed to the graph below, shows when ice first began its advance into Wisconsin (A), ice near its maximum extent (B and C), the initial retreat (D), when ice left Wisconsin (E), and the final major readvance (F).





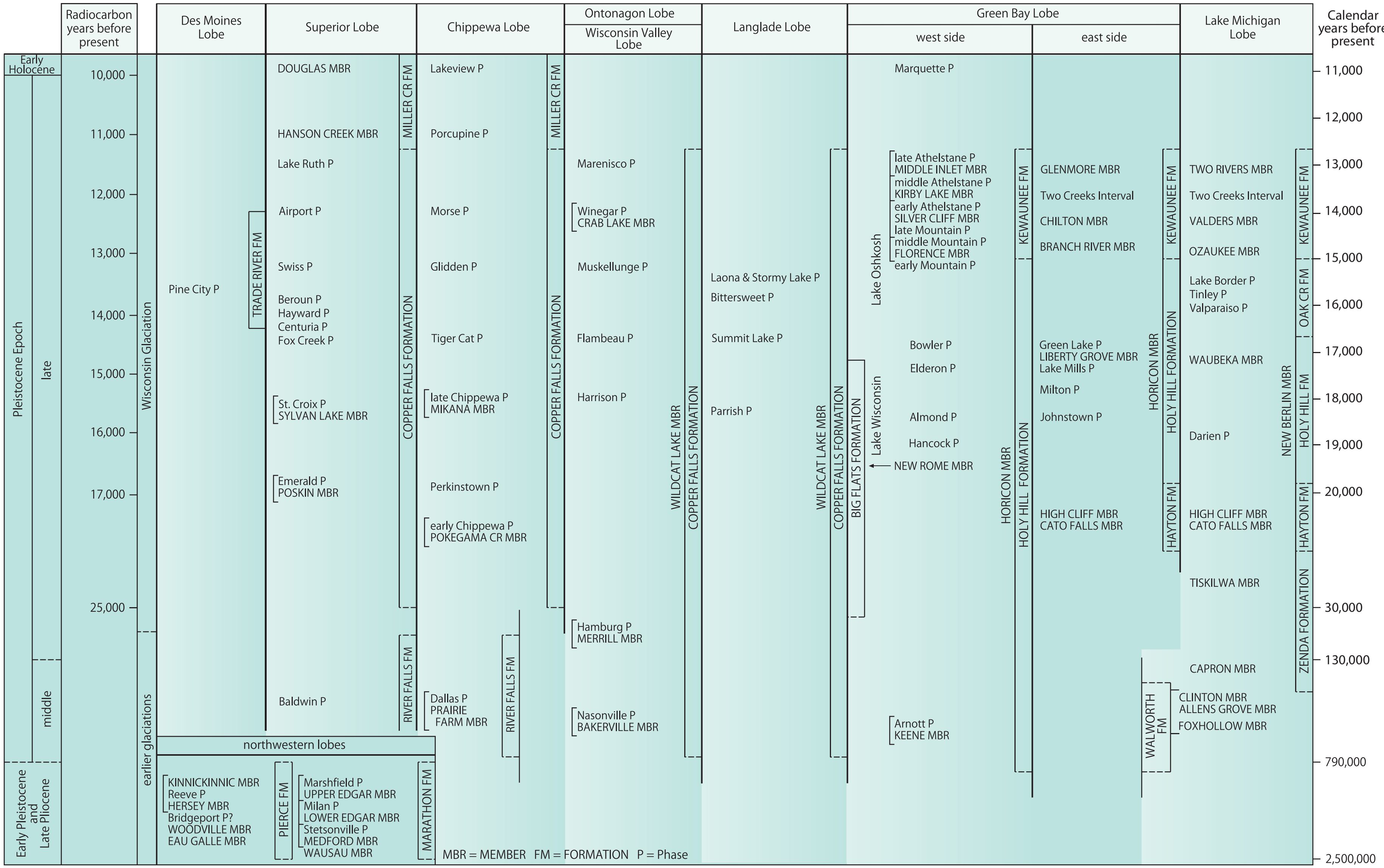
Phases of glaciation



Ages of glaciation. In this map and the one on the last page, areas are distinguished by age: older or younger than about 35,000 years. Ages are determined using geochronology (radiocarbon and other dating techniques) and by studying features in the landscape. Younger glacial features are relatively fresh and uneroded; older glacial features are mostly or completely worn away.

A **phase** is a geologic event rather than a period of time. Most phases represent at least a minor advance of the edge of the Laurentide Ice Sheet. Each line marks the edge of the ice sheet during a phase of glaciation. For example, during the Johnstown Phase of the Wisconsin Glaciation, the southern edge of the Green Bay Lobe (see back page for lobe locations) of the Laurentide Ice Sheet advanced to the line marked “Johnstown” in southcentral Wisconsin. Only the most recent phase is shown at any location.

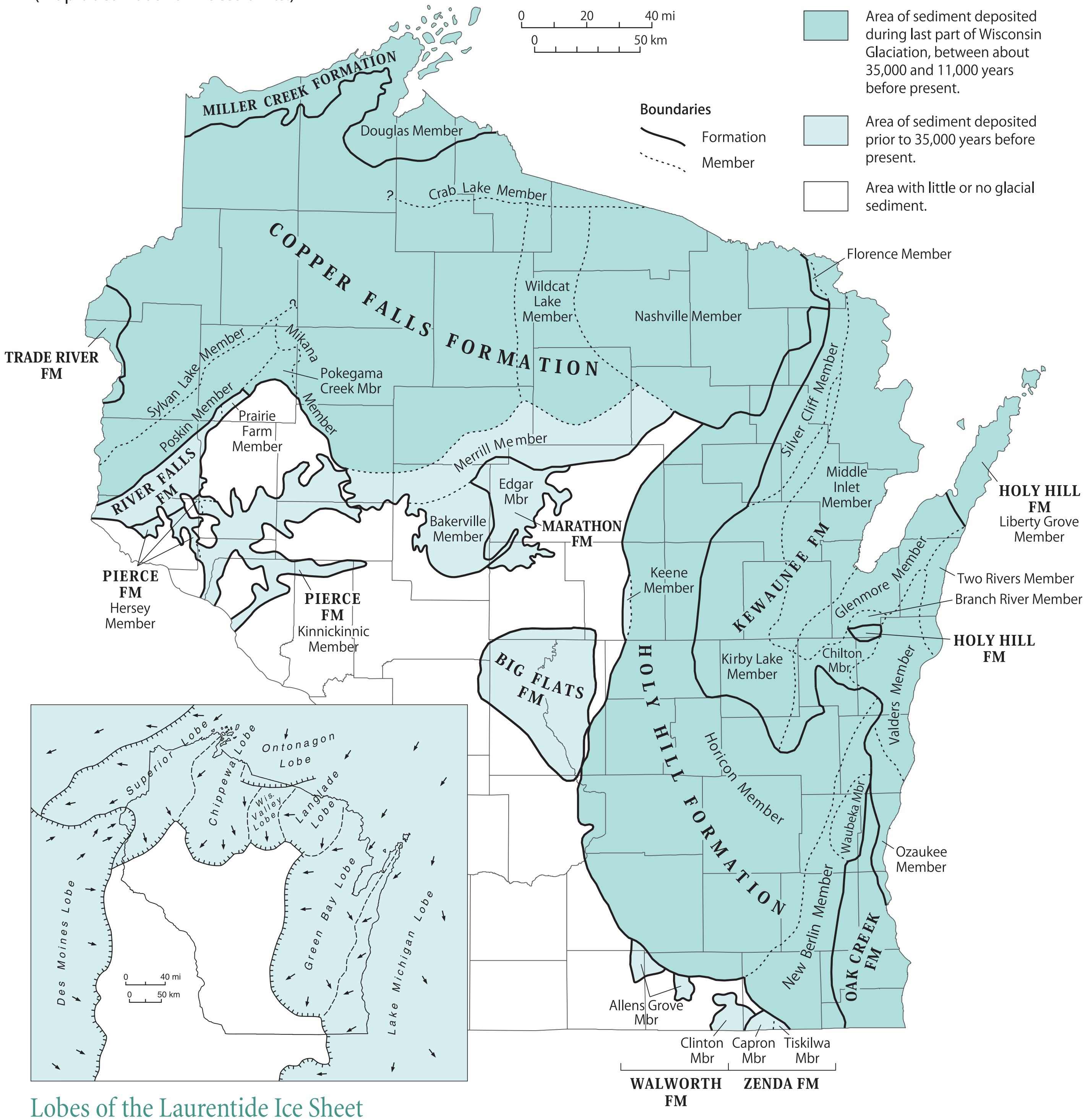
Correlation of Ice Age events and lithostratigraphic units across Wisconsin



Events (phases) are shown in lowercase letters, and lithostratigraphic units (members and formations) are in uppercase. A lithostratigraphic unit is a layer of geologic material having a given set of physical characteristics and a specific position within a sequence of units. Most lithostratigraphic units in this figure contain till (glacial sediment) and meltwater-stream sediment, and some glacial-lake sediment. When a specific event was responsible for a specific lithostratigraphic unit, the event is bracketed with the lithostratigraphic unit. Lobes are shown on the last page.

Distribution of Pleistocene lithostratigraphic units

(Map does not show loess units.)



Lobes of the Laurentide Ice Sheet

Arrows indicate the direction of ice movement.

For additional information, see the *Lexicon of Pleistocene Stratigraphic Units of Wisconsin*, Wisconsin Geological and Natural History Survey Technical Report 1.

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James M. Robertson, Director and State Geologist

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Lesson Plan for People of the Waters Exhibit: Journey through Time
Rock Wall

Lesson Name: **Rock 'N Fossils**

Grade: **High School**

Subject Area(s): **Science**

Objectives: Students will engage in an exploration of fossils and become familiar with the type of work of paleontologists conduct by working on their own or with a partner to observe, identify, and make inferences about fossils like the ones on display in the *People of the Waters* "Rock Wall" exhibit. Students will use their observations and their prior knowledge of the environment and modern day processes to make inferences about the environments in which fossilized organisms once lived. Students will make predictions, compare results, and discuss their findings.

Standards Addressed:

Science

Science Connections: A.12.6, A.12.7
Nature of Science: B.12.5
Science Inquiry: C.12.5, C.12.6
Science, Earth and Space: E.12.3

Materials:

- Publication: *Common Paleozoic Fossils of Wisconsin* by Ross H. Nehm and Bryan E. Bemis
- Image and Description of Rock Wall Display
- List of Limestone Wall Fossils

Activity:

1. Each student will select a fossil either featured in the *Common Paleozoic Fossils of Wisconsin* publication or one featured in the *People of the Waters* "Rock Wall" display (see list). They will have to research their selected fossil and produce a report/presentation about it, incorporating answers to questions such as:

    - What is the fossil you selected?
    - Where are fossils such as this one found?
    - What kind of information can be inferred from the fossil you selected?
    - What can the fossil you selected tell us about the environment it existed in long ago? Do you know what it looked like before it became a part of the fossil record?
    - What characteristics allowed for this specimen to become fossilized?

Image and Description of Rock Wall Display

Exhibit Area A: Journey Through Time-Entry Wall and Introduction

A wall—half painted and half cultured rock tile—forms the introduction to the *People of the Waters* exhibition. The rock half of the introductory wall features cultured stone tile that resembles limestone from the region (such as that from Vulcan Quarry in Oshkosh). Reproduction bas-relief fossils are inset amidst the limestone tiles (locations highlighted in image below). See the "List Limestone Wall Fossils" for information about featured specimens.

List of Limestone Wall Fossils

Limestone Wall Fossils

Catalog / Objectid / Objname	Description
O 498-T2 Fossil 	Streptelasma corniculum (Hall). Trenton formation.
O 529 Fossil 	8/8/16 ID by Joe Peterson, UW Oshkosh: Injection mold of an ordovician bivalve. From a quarry near Woodford.
O 535 Fossil 	Protokinoceras Meaullare. From about ten feet below the surface of a quarry between Genesee Depot and Waukesha. 8/8/16 ID by Joe Peterson, UW Oshkosh: nautiloid orthoceras
O 576 Fossil 	Clathospira aubconica (Hall). Trenton formation. From a quarry near Woodford.

Catalog / Objectid / Objname	Description
O 800-P645 Fossil 	Receptaculites Oweni.
O 965-642 Fossil 	Plateptrophia lynx. 8/8/16 ID by Joe Peterson, UW Oshkosh: Spiriferid brachiopod
O 6776-33 Fossil 	8/8/16 ID by Joe Peterson, UW Oshkosh: Paleozoic Pentamerid brachiopod.
O NC-624 Fossil 	trilobite one trilobite impression in grey matrix one smaller mineralized trilobite in grey matrix 8/8/16 ID by Joe Peterson, UW Oshkosh: Calymene celebra
O P673 Fossil 	8/8/16 ID by Joe Peterson, UW Oshkosh: coiled nautiloid cephalopod.

Common Paleozoic Fossils of Wisconsin

Ross H. Nehm
Bryan E. Bemis

Wisconsin Geological and Natural History Survey
Educational Series 45 | 2002

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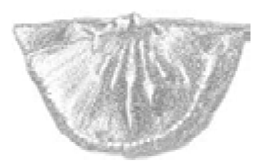
The Wisconsin Geological and Natural History Survey also maintains collaborative relationships with a number of local, state, regional, and federal agencies and organizations regarding educational outreach and a broad range of natural resource issues.

Common Paleozoic Fossils of Wisconsin



Ross H. Nehm
Bryan E. Bemis

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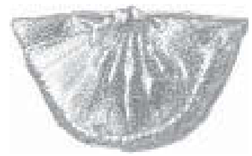
The Survey conducts earth-science surveys, field studies, and research. We provide objective scientific information about the geology, mineral resources, water resources, soil, and biology of Wisconsin. We collect, interpret, disseminate, and archive natural resource information. We communicate the results of our activities through publications, technical talks, and responses to inquiries from the public. These activities support informed decision-making by government, industry, business, and individual citizens of Wisconsin.

Figures

Table

Plates

Common Paleozoic Fossils of Wisconsin



Overview

Wisconsin's fossils

Many people view the Earth and its lifeforms as what we see today. However, both have changed dramatically through time; the evidence for this comes from something most of us see every day, but think little about: rock. Much of the rock in Wisconsin contains *fossils,* the remains of ancient organisms. After these organisms died, parts of their bodies were preserved in rock. Paleontologists—people who study ancient life on the basis of fossilized plants and animals—use them as clues about the Earth's past.

The fossils found in rock throughout Wisconsin were formed from creatures that lived in the warm, shallow seas that once covered the state. In this guide we introduce the fascinating *marine* (sea) creatures that existed in what is now called Wisconsin, discuss how they were preserved as fossils and what they tell us about the ancient Earth, illustrate common Wisconsin fossils, and suggest how and where to collect them.

Geologic time

When did the creatures that were to become fossils live? To appreciate fully just how long ago these organisms existed, it is helpful to develop an understanding of the concept of *geologic time*.

Scientific methods for determining ages indicate that the Earth is about 4.6 billion years old. It is difficult for most of us to imagine such a vast amount of time, so geologists have developed a timetable (see inside back cover) that breaks geologic time into major units. The most expansive units, covering the longest amounts of time, are called *eons*. The next unit of time is the *era,* which is further subdivided into *periods*.

Geologic time is divided into three eons. From oldest to most recent, these eons are the *Archean, Proterozoic,* and *Phanerozoic*. The Archean and Proterozoic (sometimes collectively referred to as the Precambrian) encompass geologic history prior to 570 million years ago. Fossils representing these two eons, when the earliest forms of primitive life developed, are uncommon. The oldest known single-celled organisms—bacteria that were beautifully preserved in rock that is 3.5 billion years old—were discovered in Africa. Fossils of soft-bodied multicellular organisms about 700 million years old have been found in Australia's Ediacara Hills.

The *Phanerozoic* has been divided into three principal eras; from oldest to youngest, they are the *Paleozoic* (upon which we focus in this booklet), *Mesozoic,* and *Cenozoic*.

Diversity of lifeforms and the complexity within them developed during the early part of the Phanerozoic, in the Paleozoic Era, 570 to 245 million years ago. This era has been divided into (from oldest to most recent) the *Cambrian, Ordovician, Silurian, Devonian, Mississippian, Pennsylvanian,* and *Permian Periods*. Many major groups of *shell-bearing invertebrates* (animals with hard shells and no backbones) appeared throughout the oceans during an immense proliferation of lifeforms at the beginning of the Paleozoic. This era ended with the largest extinction in the Earth's history: 80 percent of all types of marine invertebrates became extinct at the end of the Paleozoic, during the Permian Period.

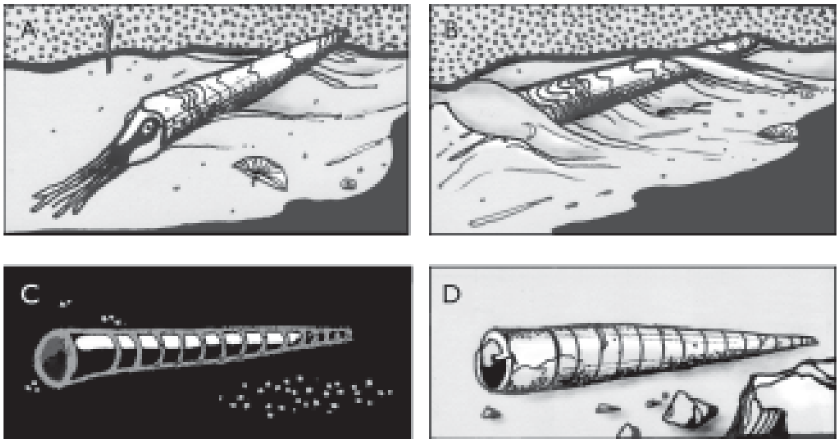


Figure 1. How fossils form. A: An animal dies and settles to the sea floor. B: Animal is buried and soft tissues decay. C: Hard parts are slowly replaced by minerals. D: Sediment becomes rock and erosion exposes fossil.

The Mesozoic Era (245 to 66 million years ago) is also called the Age of Reptiles because of the extensive proliferation of land and sea reptiles. Dinosaurs were one of the dominant animal groups during the Mesozoic Era. Although Wisconsin contains only a sparse geologic record of the Mesozoic, we know from the fossil record in other areas that many marine and terrestrial animals, including dinosaurs, became extinct near the end of this era. Mammals and flowering plants became common during about the last two-thirds of the Mesozoic.

The Cenozoic Era encompasses the past 66 million years of Earth's history. The most recent Ice Age began about 2.5 million years ago, during the Cenozoic.

How and where fossils form

Because fossils form under specific conditions, only a small percentage of organisms is preserved. Hard skeletal parts such as shells, bones, and teeth are the most commonly fossilized remains because they are more durable than the soft tissues, which decay rapidly.

Fossils are preserved in *sedimentary* rock, which is formed from what is essentially scrap material: Weathering processes break up and erode rocks at the Earth's surface, and wind and water carry away the scraps—pebbles, sand, silt, and clay. Many of these particles, called *sediment,* then settle on sea bottoms. As sea creatures die and also settle to the seafloor, they eventually are buried by sediment (fig. 1). Eventually, compaction of the sediment *consolidates* (solidifies) the sediment into layered rock, and, if conditions are right, the remains of organisms preserved in this rock become fossils (fig. 2).

Fossils can be preserved in such sedimentary rock types as *sandstone, shale, limestone,* and *dolomite.*

Sandstone, which is composed of sand-sized particles, forms in water in areas such as surf zones and beaches. Wave action is strong in these areas, and rock formed there contains few well preserved fossils—skeletal parts are easily shattered in these high-energy environments. Fossil-bearing Cambrian sandstone is exposed at the surface in central and northwestern Wisconsin. Middle Ordovician sandstone is found primarily along river valleys in southern Wisconsin, but it is generally devoid of fossils. Wisconsin sandstone can be white, tan, or iron-stained brown.

Unlike sandstone, *shale* forms in areas of slow-moving or still water; as a result, fossils in shale are generally better preserved than those in sandstone. Shale is composed of silt and clay and can be split into thin sheets. It is most common in the upper Ordovician and Devonian rock of eastern Wisconsin and is generally green, blue green, or black.

Limestone forms from the *precipitation* (settling out) of calcium carbonate from ocean water in warm, shallow environments away from the input of sand, silt, and clay. Limestone can also be composed of skeletal fragments and frameworks of organisms that built their shells with calcium carbonate from the water.

Limestone becomes *dolomite* when the element magnesium replaces some of the original calcium. Much limestone in Wisconsin has been altered to dolomite. Because of this alteration, fossils in dolomite are not as well preserved as those in limestone. Fossiliferous dolomite and limestone are found in southern and eastern Wisconsin. Limestone and dolomite range from buff or gray to dark gray or blue gray.

Conditions at a burial site determine how an organism is preserved. Fossils of marine invertebrates in Wisconsin are most commonly preserved as replacements or molds. *Replacements* are produced when minerals settle out of water and replace the original skeletal parts. *Molds* are three-dimensional impressions left in rock after the skeletal parts of an organism dissolve. A mold can be either internal or external. The impression of the outside of a preserved shell is called an *external mold;* if minerals or sediment fill the space between two shells, but the shells dissolve, an *internal mold* is formed.

Under certain conditions, the remains of some ancient plants and animals become *fossil fuels.* Coal is formed from the accumulation and burial of plant material under conditions lacking oxygen, such as in swamps. Over millions of years, high pressures and temperatures force oxygen and hydrogen out of the remains, leaving carbon, which we burn as fuel. Natural gas and petroleum form similarly, but they may include animal remains as well and form under higher pressures and temperatures. About 85 percent of the energy used in the United States comes from these fossil fuels.

What fossils tell us

About evolution and extinction

As you become familiar with Wisconsin's Paleozoic fossils, you may notice that fossils of certain organisms have different *morphologies,* or forms, through time. Some organisms develop new features (for example, shells that are thicker or shaped differently). These changes through time are known as *evolution.* How and why these changes come about, or why they don't, are the focus of much research.

Fossils also show us that many groups of creatures eventually become extinct. Trilobites, once plentiful in the Cambrian seas of Wisconsin, are extinct today, along with countless other creatures. Why are trilobites extinct, but direct descendants of other creatures that lived during the Paleozoic, such as snails, abundant today? Some creatures survive periods during which many other organisms become extinct. Does this happen because they are better adapted to their environment than those that became extinct, or are they just lucky? Paleontologists are working to answer these questions.

About ancient environments

What was the area we now call Wisconsin like 400 million years ago? It is possible to determine the environmental conditions of the past on the basis of the organisms that lived in an area at a certain time. Using information from living relatives of extinct creatures and assuming that similar, related creatures lived in similar habitats, we can make inferences about the past. For example, one indicator of marine environments is coral. Today, corals and coral reefs require specific conditions to flourish—warm temperatures (25°C to 29°C [77°F to 84°F]), shallow depths (less than 56 meters [165 feet]), and normal *salinity* (the total quantity of dissolved salts in water; normal salinity is approximately 35 parts per thousand). The abundance of coral fossils in Wisconsin's Silurian-age rock suggests that a warm, shallow sea of normal salinity covered Wisconsin during that time.

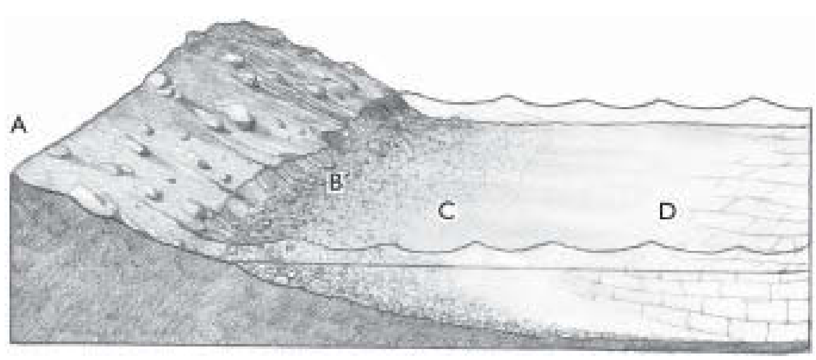


Figure 2. Block diagram of near-shore sedimentary environments. A: Eroding land is the source of sediment. B: Sand becomes sandstone. C: Silt and clay become shale. D: Farther from sediment sources, skeletal remains and calcium carbonate from ocean water become limestone.

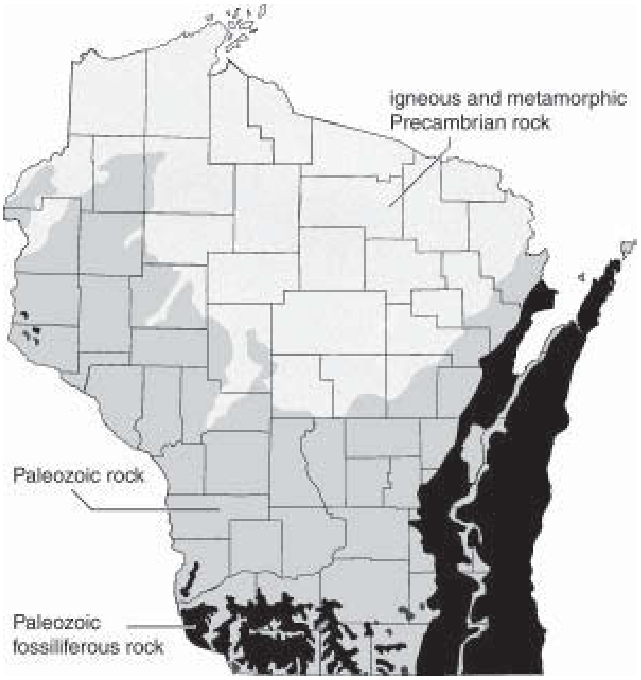


Figure 3. Where to find Paleozoic invertebrate fossils. Black areas are promising localities for collecting fossils.

Many other organisms can be used to reconstruct aspects of the Earth's ancient environment as well. Knowing how life has responded to environmental changes in the past may help us understand how future environmental changes, such as possible global warming, will influence life on Earth.

About the age of rock

Fossils can generally be considered the same age as the rock in which they are found. The age of rock can be determined *relatively* or *absolutely*, just as events can. For example, we know that Wisconsin became a state *relatively* later than the explorations of Marquette and Joliet. But when exactly did both events happen? Speaking in *absolute* terms, Marquette and Joliet's expedition began in 1673 and Wisconsin became a state in 1848.

Different rock layers can be dated relatively on the basis of their position in a "stack" of layers. For example, if you were to drop some sheets of paper on the ground, one on top of the other, it's obvious that the ones on the top got there more recently than the ones on the bottom. In the same way, rock layers (and the fossils they contain) on top of others are relatively younger than the rock layers below, if the rock has not been overturned by geologic processes.

One way you may be able to determine the geological period (age range) from which you are collecting is the presence of *index fossils* in the rock layers. Index fossils are fossil groups that lived for very short, specific periods of time. That makes them more useful for relative dating of rocks than long-lived fossil groups because they allow you to narrow down a rock's age range. Geologists can use several index fossils together to make determinations about relative rock ages.

The discovery of radioactivity provided a means of establishing absolute dates of rock. Radioactive *parent* (original) elements decay at a constant rate to produce *progeny* (decayed; also referred to as daughter) products. By knowing the *half life* (decay rate) and measuring the amount of parent and progeny products in a rock sample, it is possible to determine how much radioactive decay has occurred and therefore the time that has passed, which gives us the absolute age of the rock. Paleontologists can use a combination of relative and absolute methods to determine the age of rocks and fossils.

Collecting fossils

Finding fossils in Wisconsin

Fossils can be found in many places in the state. Fossil-bearing sedimentary rock covers much of Wisconsin, particularly the far southern and eastern parts of the state (fig. 3).

But you may not have to travel far to find fossils—the gravel in your driveway, the rocks in your garden, and the stone in buildings near you may have fossils in them. The most abundant and most easily collected fossils come from roadcuts, natural bluffs, and quarries. Roadcuts containing fossils can be found throughout Wisconsin, particularly in the southwest (fig. 4). Natural bluffs are along rivers and streams.

Quarries are excellent places to look for fossils as well, but falling rocks can make them dangerous. Do remember that many good collecting localities, such as quarries and roadcuts, are private property—***always secure permission with quarry and landowners before entering a collecting site. Use care along roadcuts.***

Here we list only general localities for fossil collecting: If we provided directions to specific sites, they might become overcollected. In many cases, the best finds are those that you discover on your own. This is part of the excitement of fossil collecting! *Refer to later sections of this guide for descriptions of specific fossil groups mentioned below.*

Eastern Wisconsin

■ Door County. Many bedrock exposures in Door County contain Silurian brachiopods (especially *Pentamerus*) and rugose and tabulate corals. Fragments of Silurian fossils are also found along the shore of Lake Michigan.

■ Oakfield, Wisconsin. An abandoned brickwork quarry southwest of Oakfield contains upper Ordovician orthid brachiopods. Many of these brachiopods have been eroded out of their matrix and can be picked from the ground. Above the shale in the lower quarry lie harder dolomite that contains layers packed with shell fragments of bryozoans and brachiopods. Fossils have been collected from this site for over a decade, but it still provides some good specimens.

■ Mayville, Wisconsin. The large quarries of the Mayville Lime Company near Mayville contain a few corals as well as casts and molds of abundant specimens of the brachiopods *Pentamerus* and V*irgiana*. ***Collecting permission is required.***

■ Washington County. In a quarry near Grafton, large blocks of reef material—including Silurian gastropods, brachiopods, and crinoid stems—are sometimes exposed. ***Collecting permission is required.*** Silurian corals can also be found on stone fences and rock piles throughout the county.

■ Cedarburg and Grafton, Wisconsin. Outcrops and quarries on the banks of the Milwaukee River between Cedarburg and Grafton contain Silurian fossils.

■ Waukesha County. Many of the best Silurian fossils from Wisconsin come from quarries in the metropolitan areas of eastern Wisconsin. Fossils in these quarries are rare but well preserved. Many beautiful specimens from these quarries are now in museums.

■ Green Bay, Wisconsin. Near Green Bay, outcrops of upper Ordovician Maquoketa Shale contain bryozoans and brachiopods, as does a roadcut on Highway 57 north of Green Bay. Other exposures along river banks in the area also contain Ordovician fossils.

Central and western Wisconsin

Middle Ordovician dolomite that is rich in virtually all types of invertebrate fossils is found in many localities in central and western Wisconsin. The most well preserved fossils come from the Platteville Formation of the Sinnipee Group. These fossils include brachiopods, bivalves (clams), gastropods (snails), trilobites, hyolithids, cephalopods, ostracods, crinoid columnals, and corals.

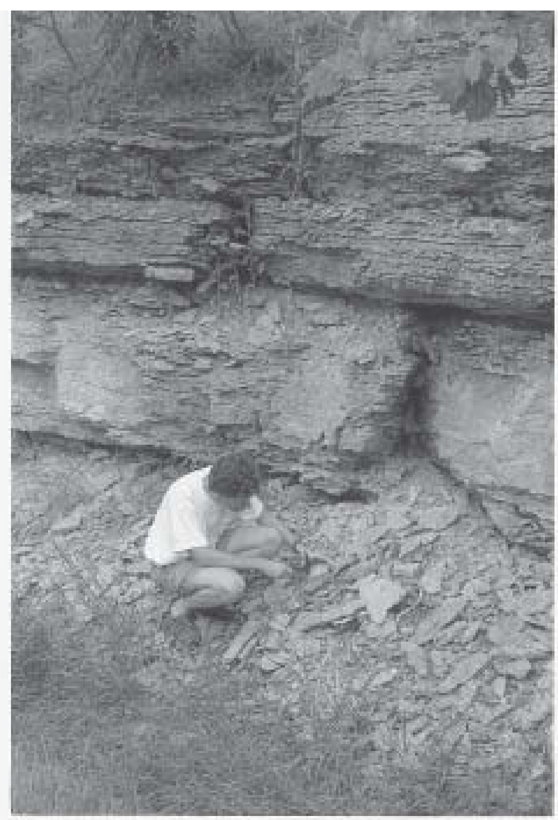


Figure 4. A paleontologist collecting Middle Ordovician fossils from a roadcut in southwestern Wisconsin.

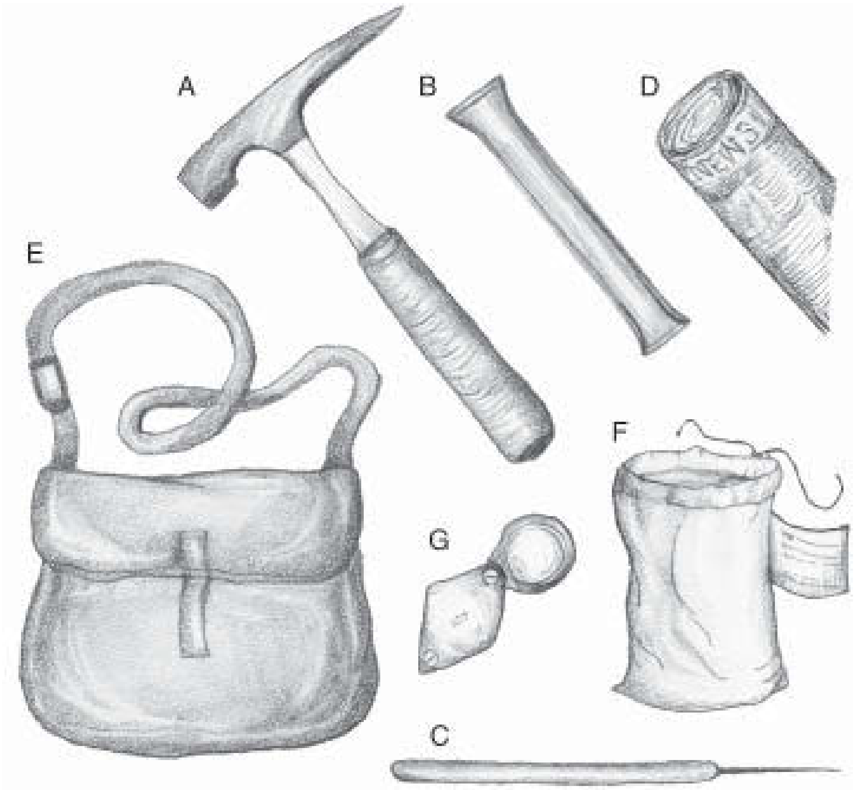


Figure 5. Tools for fossil collecting. A: Bricklayer's hammer. B: Chisel. C: Dental tool for removing delicate fossils. D: Newspapers for wrapping specimens. E: Backpack for storing tools and specimens. F: Specimen bag with label. G: Hand lens.

■ Sun Prairie, Wisconsin. Two quarries about 6.4 kilometers (4 miles) northeast of Sun Prairie off Highway 151 contain abundant Ordovician fossils from the Platteville Formation. These quarries have been active recently, and fresh rock has been exposed. In 1991 most of a cephalopod *(Endoceras)* approximately 4 meters (13 feet) long was discovered along with other excellent fossils. ***These are active quarries; secure permission from owners before entering.***

■ Dickeyville, Wisconsin. A roadcut about 6.4 kilometers (4 miles) northwest of Dickeyville in Grant County on Highways 35 and 61 contains weathered strophomenid brachiopods, bryozoans, ostracods, crinoid columnals, and other invertebrate fossils.

■ Platteville, Wisconsin. Roadcuts directly southwest of Platteville in Grant County are fossiliferous. A quarry off Highway 151 north of Dickeyville contains the brachiopod *Pionodema* and other common Ordovician fossils.

■ Mount Horeb, Wisconsin. Roadcuts along Highway 151 south of Mount Horeb occasionally contain *Receptaculites*, marine organisms that may be algae. Quarries and roadcuts just south of Mount Horeb contain Ordovician fossils, including strophomenid brachiopods, bryozoans, ostracods, and trilobite fragments.

■ Fennimore, Wisconsin. Roadcuts west and south of Fennimore contain well preserved Ordovician brachiopods, trilobites, ostracods, bryozoans, and cephalopods.

■ Roadcuts along Highways 18 and 35 east of Wyalusing State Park contain Ordovician fossils from the Platteville Formation of the Sinnipee Group, such as brachiopods, trilobite fragments, bryozoans, cephalopods, and clams.

Tools for collecting fossils

Fossil collecting is an inexpensive hobby. The following items are helpful when collecting (fig. 5):

■ **A bricklayer's hammer**. The long, flat, tapered end of a bricklayer's hammer is ideal for splitting sedimentary rock layers.

■ **A chisel**. Chisels are needed for chipping a fossil from a large piece of rock. Safety glasses should always be worn when removing fossils by this method.

■ **Dental tools**. Dental tools are useful in the removal of delicate fossils.

■ **Old newspapers**. Ensuring that a specimen is not damaged requires nothing more than a careful wrapping with newspapers.

■ **Pencil and paper**. These items are essential for labeling specimens and precisely recording where your fossil was found.

■ **A backpack**. A backpack provides a place to for tools, specimens, and maps.

■ **Specimen bags**. Use separate specimen bags for each locality.

■ **A magnifying glass or hand lens**. The details of many fossils cannot be seen with the naked eye, and magnification is helpful for identification.

Removing fossils from rock

Considerable care must be taken when removing fossils from rock. Many fossils are fragile and cannot be removed without damage. It is generally best to take a large sample home and there carefully and patiently work the specimen out. Many superb specimens have been destroyed by impatient collectors attempting to remove them quickly in the field. Chiseling a shallow trough around the fossil and then popping it out usually works well (fig. 6). Large rocks can be trimmed to smaller sizes by hanging the excess area over the edge of another rock and striking the large rock firmly.

Recording information about fossils

Amateurs have found many important fossil specimens. However, without detailed locality information, fossils are virtually useless to paleontologists. When collecting fossils, label specimens and record the following information:

■ **Locality**. Be sure to record the county, nearby roads, and distinguishing features of your collecting site.

■ **Rock description**. Include a description of the fossil-bearing rock type (that is, sandstone, shale, or limestone/dolomite), including color.

■ **Layer in rock**. It is useful to describe the specific fossil location in relation to layering visible in the rock. For example, you may notice that rock in some outcrops is punctuated by thin, horizontal layers composed primarily of fossil fragments. Describing the location of fossils relative to such layers allows you (and others) to find your exact collecting locality again.

■ **Interesting features**. It may be helpful to include a sketch or description of any other interesting features of the quarry or outcrop, such as unique layering patterns.

Identifying fossils

Throughout time, humans have sought to name things in the world; in biology and paleontology, this naming process is called *taxonomy.* Taxonomy involves naming groups of organisms, and a taxon (plural, taxa) is a unit of any rank in this naming process. Grouping organisms by shared characteristics is known as *systematics.* Organisms described within large groups, such as kingdoms, contain organisms with general similarities; those within smaller groups, such as families, have specific similarities.

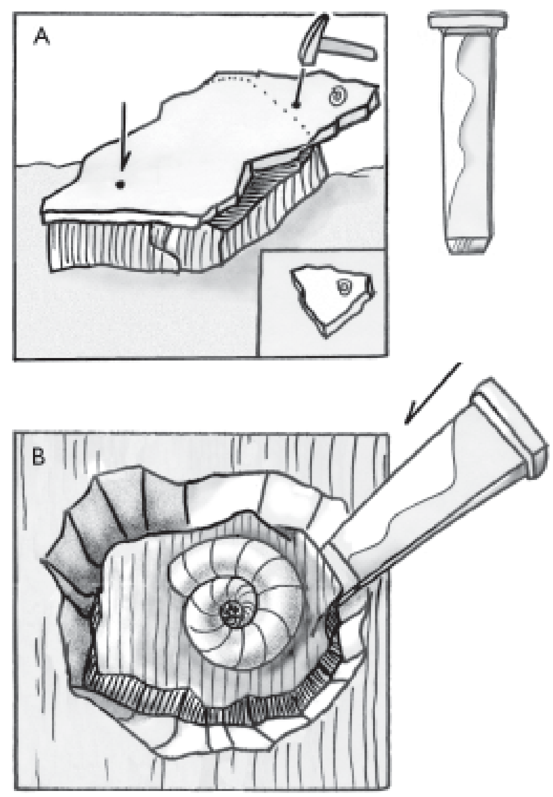


Figure 6. Removing fossils from rock.
A: Trimming a large rock to a smaller size.
B: Close-up of chiseling out a fossil.

The most precise way to identify a fossil is by its two-part scientific name. The first part of the name is the *genus* (plural, genera); the second, the *species.* A genus includes species that are related to each other; the members of a species are usually morphologically similar and are able to breed with each other and produce fertile offspring. The scientific name is usually written in italics. For example, in the case of *Calymene celebra,* Wisconsin's state fossil, *Calymene* is the genus and *celebra* is the species.

This complete hierarchy is shown in the example of trilobites in column two of table 1, in

Figure 7. Reconstruction of stromatolite mounds in the Cambrian Period (500 million years ago) of Wisconsin.

which *Calymene celebra* is a member of a larger group, the trilobites. Trilobites are themselves members of the animal kingdom.

In this guide, we use scientific and common names (such as lamp shells for brachiopods) to describe the major fossil groups in Wisconsin. We discuss how, where, and when these intriguing organisms lived and illustrate the common genera found within these groups.

Many other types of invertebrate fossils also lived, died, and were preserved in Wisconsin rock; therefore, further sources of information may be necessary to identify the fossils you find. Two of the most complete sources are the *Treatise on Invertebrate Paleontology*, a series of more than forty volumes containing descriptions of all known invertebrate genera, and Shimer and Schrock's *Index Fossils of North America*. These and other references are listed in the *Sources of information* section at the end of this guide.

Stromatolites

Approximately 3 billion years ago, long before multicellular organisms roamed the earth, lush mounds of algae began to thrive along warm, shallow shorelines (fig. 7). These algal mats trapped sediment, which built up layer by layer into dome-shaped mounds (fig. 8). Such mounds are called *stromatolites.* Although they are not animals, stromatolites may have been a food source for some of the animal groups we describe. Stromatolites were abundant in the Precambrian and Cambrian, but their numbers decreased in later times. A few stromatolites are still forming today. Shark Bay, Australia, is well known for its abundant living stro-

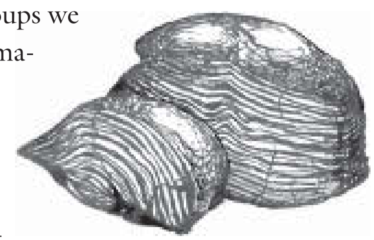
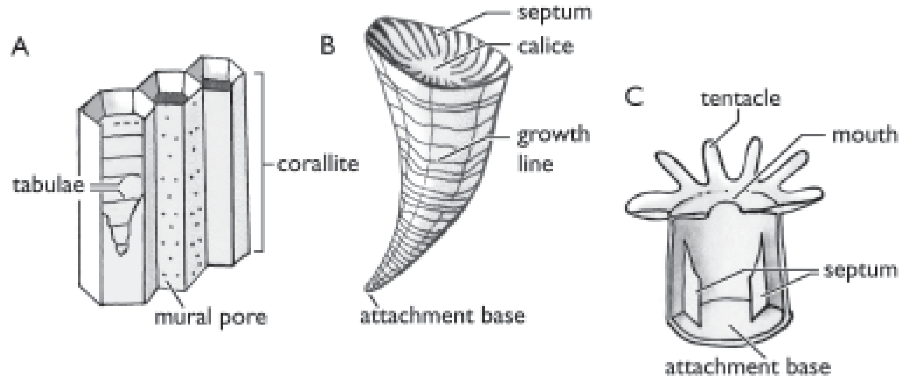


Figure 8. A stromatolite, showing the characteristic layered and domed structure.

Table 1. A classification of three specimens (after Easton, 1960).

Taxon	**Trilobite**	**Human**	**Car**
Kingdom	Animalia	Animalia	machine
Phylum	Arthropoda	Chordata	transportation
Class	Trilobita	Mammalia	automobile
Order	Phacopida	Primatida	gas-powered
Family	Calymenidae	Hominidae	sedan
Genus	*Calymene*	*Homo*	four door
Species	*celebra*	*sapiens*	brand of automobile
Individual	specimen number	social security number	registration number

Figure 9. Coral anatomy.
A: Tabulate coral. B: Rugose, or "horn coral." C: Living coral animal.



matolites. In Wisconsin, stromatolites were most common in Cambrian and Ordovician seas, and therefore are most common in rock of those ages.

Corals

Corals are marine animals with simple body structures (fig. 9; plate 1). The mouth of a coral's sac-like body is surrounded by a ring of tentacles. The living coral animal, the polyp, secretes a cup-like skeleton called the *corallite*. Many corallites cemented together make up the entire skeleton, or *corallum*. Inside the corallite, a radial divider, called a *septum* (plural, *septa)* grows vertically from the attachment base and helps support the soft tissues. Many coral polyps contain algal cells, which use photosynthesis to produce food for themselves and the coral.

Corals can live together in large colonies, or reefs, which can be hundreds of miles across. Coral reefs are among the most complex ecosystems on Earth because many thousands of species other than corals make the reef their home. Corals themselves require specific living conditions, so fossil coral reefs tell us a great deal about the environmental conditions at the time of reef formation. Living coral reefs are confined to subtropical regions in shallow waters that are warm and clear. Thus, Wisconsin's Silurian reefs provide evidence that the state was once covered by a warm, subtropical sea. Although ancient corals formed the reef itself, many other organisms flourished in the small habitats the reef provided. Brachiopods covered the reef structure, gastropods fed on the abundant algae and detritus, cephalopods hunted for prey, and crinoids swayed in the agitated waters.

Two groups of reef-forming fossil corals are found in Wisconsin: the tabulates and rugosans (fig. 9). Tabulate corals grow upward, depositing horizontal plates known as *tabulae*. Tabulates formed mounds that appear similar to honeycombs; the distinctive rugosan corals resemble cow horns.

Tabulate corals

Tabulate corals are the most abundant coral fossils in the Silurian rock of Wisconsin and are usually the largest reef corals. They form massive colonies, about 0.3 meter (1 foot) wide or larger. They can be identified by the presence of tabulae. Fieldstones, commonly found in fencerows along the edges of farm fields in eastern Wisconsin, in many cases contain well preserved tabulate corals. Beach pebbles and gravel along the Lake Michigan shoreline also abound with coral fragments.

Favositid tabulates: Honeycomb corals. The favositid corals are quite common. They usually formed large colonies. The corallite is prismatic in shape, resembling honeycombs. Favositids have *mural pores,* tiny holes in the wall of the skeleton, which connect different corallites. These pores are distributed in characteristic patterns and numbers, which are useful for distinguishing the various types of favositids. Favositids lived from the Ordovician to the Permian, at which time they became extinct. They are most abundant in middle Silurian to lower Devonian rock. *Favosites* is the most common fossil coral in Wisconsin.

Halysitid tabulates: Chain corals. Halysitids resemble interlocking strings of delicate chains. *Halysites* is a common chain coral in Wisconsin, and it is used worldwide as an indicator of Silurian rock. *Halysites* is best seen in weathered rock because the rock between the chains dissolves, leaving the chains beautifully exposed.

Syringoporid tabulates: Tube corals. Syringoporids are easy to identify because of the

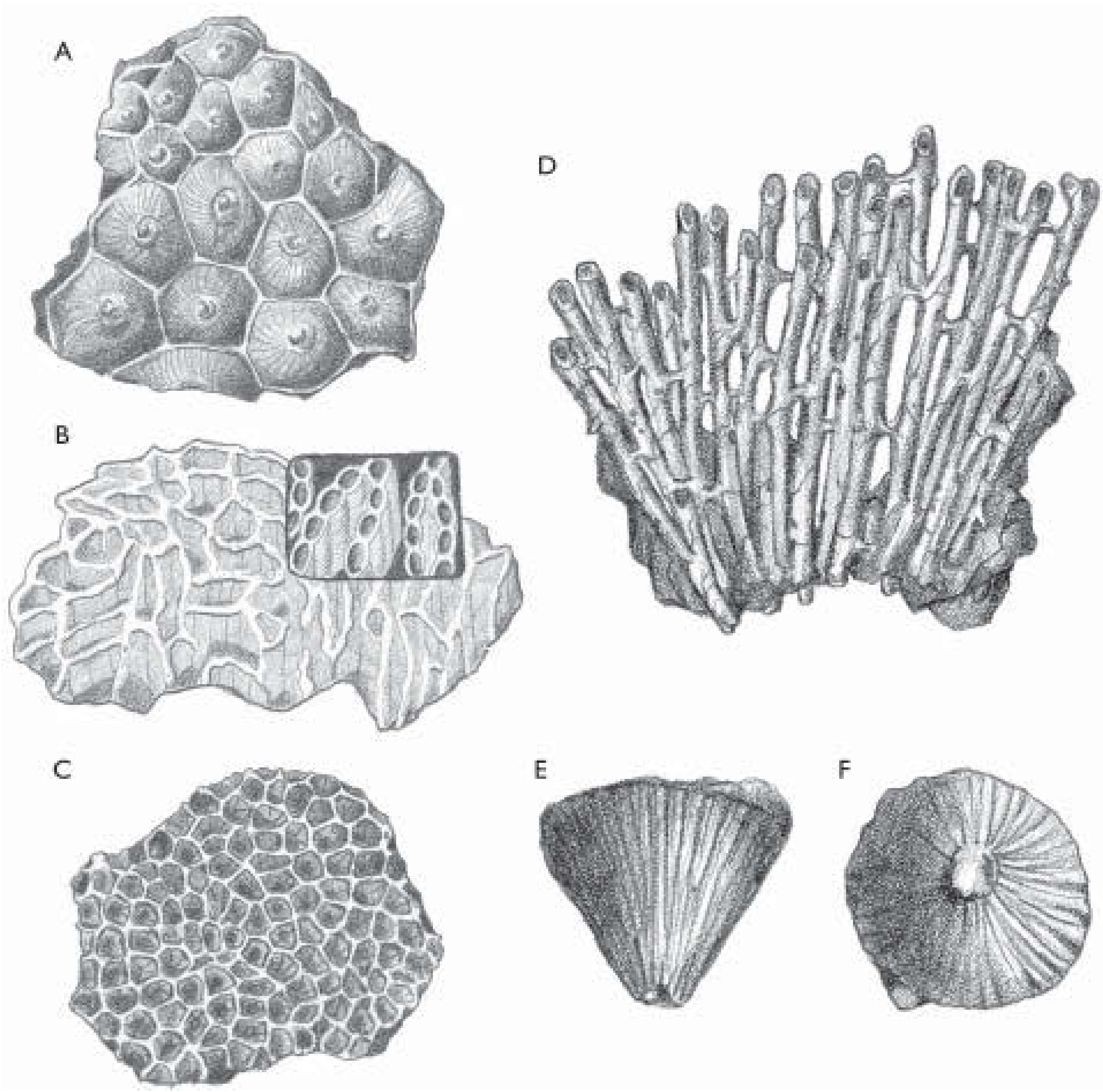
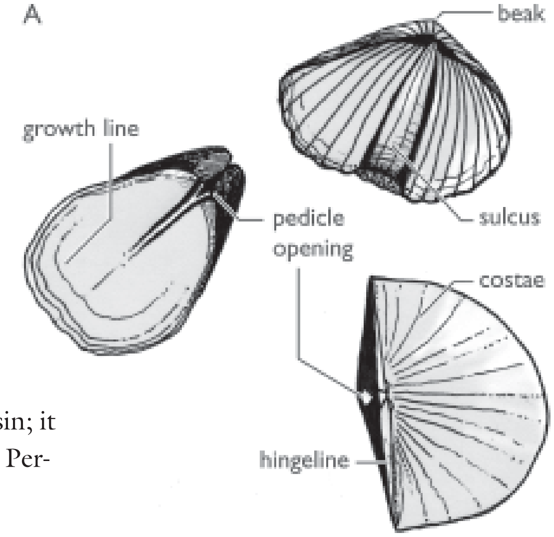
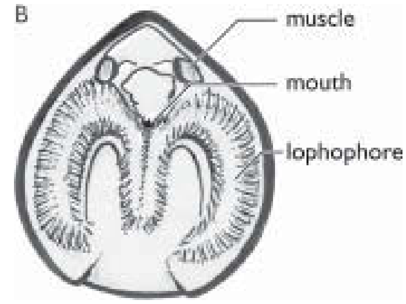


Plate 1. Coral fossils. A: Top view of large, prismatic corallites of *Strombodes*, a common coral in Silurian rock of eastern Wisconsin [8.5 cm]. B: Closeup of the chains of *Halysites*, also common in Silurian rock [7 cm]. C: Top view of small, prismatic corallites of *Favosites*, the honeycomb coral, a common fossil in Silurian rock [7 cm]. D: Side view of *Syringopora* (common in Silurian rock), showing the lateral collecting tubes [6.5 cm]. E: *Lambeophyllum*, a common coral in Ordovician rock. [2 cm]. F: *Streptelasma*, an Ordovician rugose coral that has a deep calyx and is taller than *Lambeophyllum* [4 cm].

Please note that in all the plates that the numbers in brackets following each genus refer to the general length of the longest dimension. These measurements are in the metric system because that is the system that paleontologists use. One centimeter equals about 0.39 inch.

presence of distinct tubes connecting the corallites. They are quite delicate, but in many places they have been preserved in astonishing detail. *Syringopora* is a common syringoporid in Wisconsin; it lived from the Silurian to the Permian.





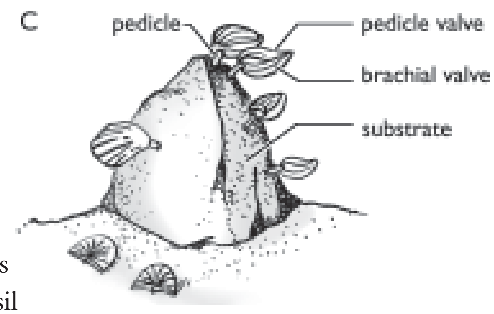


Figure 10. Brachiopod anatomy. A: External anatomy. B: Internal anatomy. C. Living brachiopods attached to rocks by their pedicles and two animals living on soft sediments.

Rugosans: Horn corals

Rugosans (plate 1) are cone-shaped corals that resemble cow horns. The polyp lived in a space in the center of the cone, known as the *calice*. Rugosan corals first appeared in the Ordovician and are the second most common type of coral in Wisconsin. Because most horn corals appear to be similar, they can be difficult to identify.

Rugose corals can be colonial or solitary. Colonial rugosans formed bunches attached to one another. Solitary rugose corals commonly were dislodged and then tipped over. If they survived, in many cases they grew upward again. Such rugosans have *geniculations* (contortions) caused by the change in growth direction. Solitary and colonial rugosans are characterized by external growth bands, which formed much like tree rings.

Rugose corals declined after the Silurian and eventually died out at the end of the Paleozoic Era.

Brachiopods: Lamp shells

Brachiopods (plates 2 and 3) are the most abundant fossils in Wisconsin. Most people are not familiar with living brachiopods because modern species inhabit extremely deep regions of the world's oceans, and their shells are rarely found on modern seashores. But during the Paleozoic, thousands of different species of brachiopods teemed in the near-shore and deep-sea environments of Wisconsin. The number of brachiopod species has decreased since the extinction at the end of the Permian (about 245 million years ago). Now, only about 250 living species of brachiopods exist; more than 30,000 fossil species have been identified in the fossil record.

Brachiopods have two *valves* (shells) that are generally of unequal size and shape (fig. 10A), but the right and left halves of each valve mirror each other. Near the tip of the bottom shell (the *pedicle valve),* a fleshy stalk (the *pedicle)* emerges through a hole (the *pedicle opening)* and attaches the animal to the sea bottom (fig. 10A, C). The other shell is known as the *brachial valve,* which contains the *brachidium*. The brachidium supports the gill-like *lophophore,* which has many filaments and *cilia* (hairs) that create currents to bring microscopic food particles to the mouth (fig. 10B). The large surface area of the filaments is used to obtain oxygen from water and eliminate carbon dioxide. The two valves join at the hinge line, which is on the shell near the pedicle (fig. 10A). Muscles hold the two valves together so that the soft parts are protected. The two valves meet at the *commissure*.

Other shell features are useful for identifying brachiopods. A *sulcus* (a groove-like depression) is present on many brachiopod shells, and a *fold* (a raised ridge) can be found on the op-

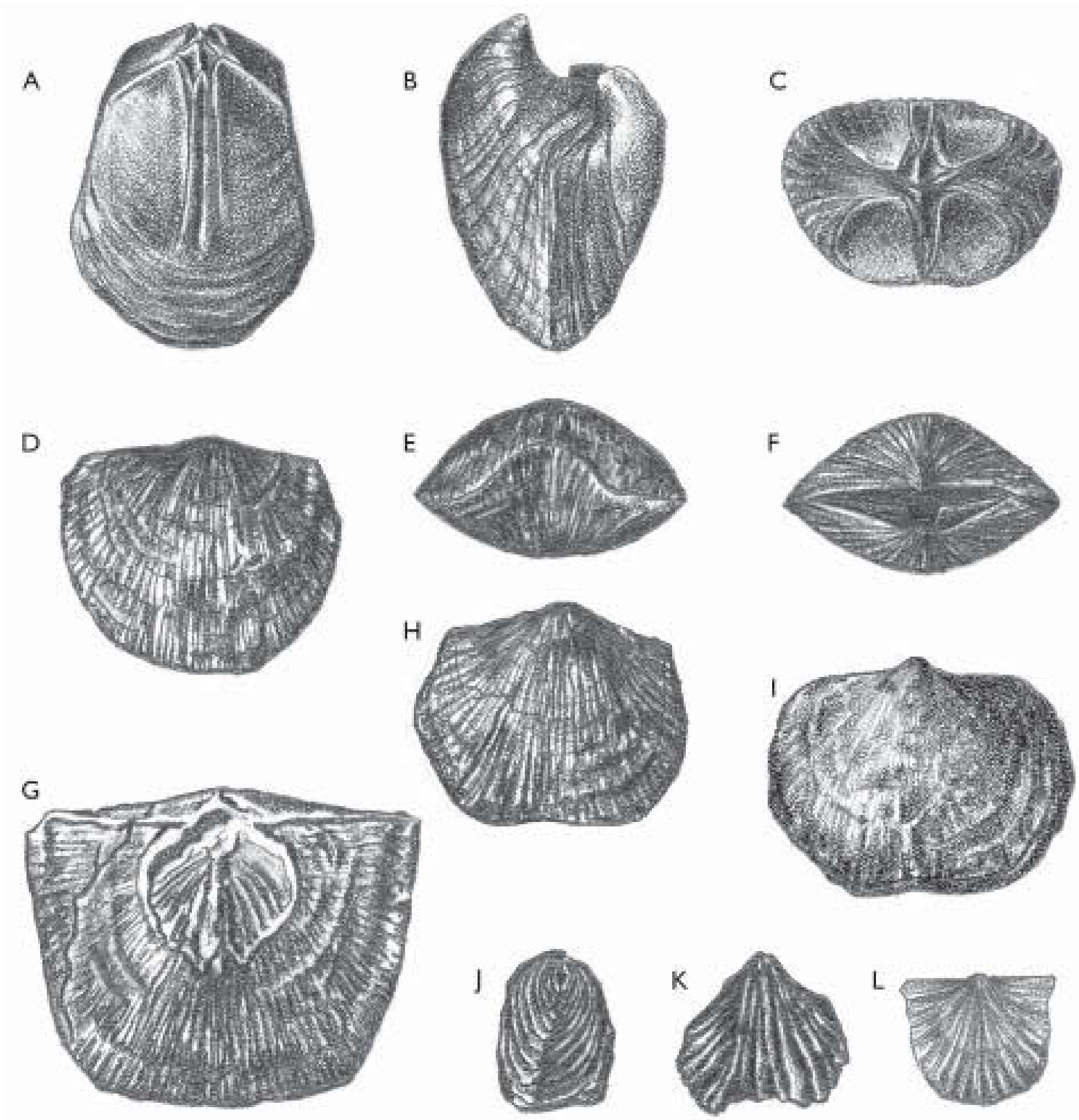


Plate 2. Brachiopod fossils. A, B, and C: Top, side, and back views of *Pentamerus*, an exceptionally common and distinctive pentamerid brachiopod in Silurian rock of Wisconsin [4.5 cm]. D: *Valcourea*, a flat Ordovician orthid brachiopod [2 cm]. E and F: Front and back views of *Pionodema*, an orthid brachiopod with a strong sulcus. It is found in large concentrations within specific layers in Ordovician rock [2 cm]. G: Interior view of *Strophomena*, an abundant Ordovician strophomenid brachiopod that is flat and broad [4.5 cm]. H and I: Two examples of *Doleroides*, a Middle Ordovician orthid brachiopod with a shallow sulcus [2 cm and 3 cm, respectively]. J and K: Side and pedicle valve views of the common Ordovician rhynchonellid brachiopod *Rhynchotrema*, showing the zig-zag commissure and sulcus [1 cm]. L: *Rafinesquina*, a Middle Ordovician strophomenid brachiopod. It is similar to *Strophomena,* but with pointed, lateral projections of the shell near the hingeline [3 cm].

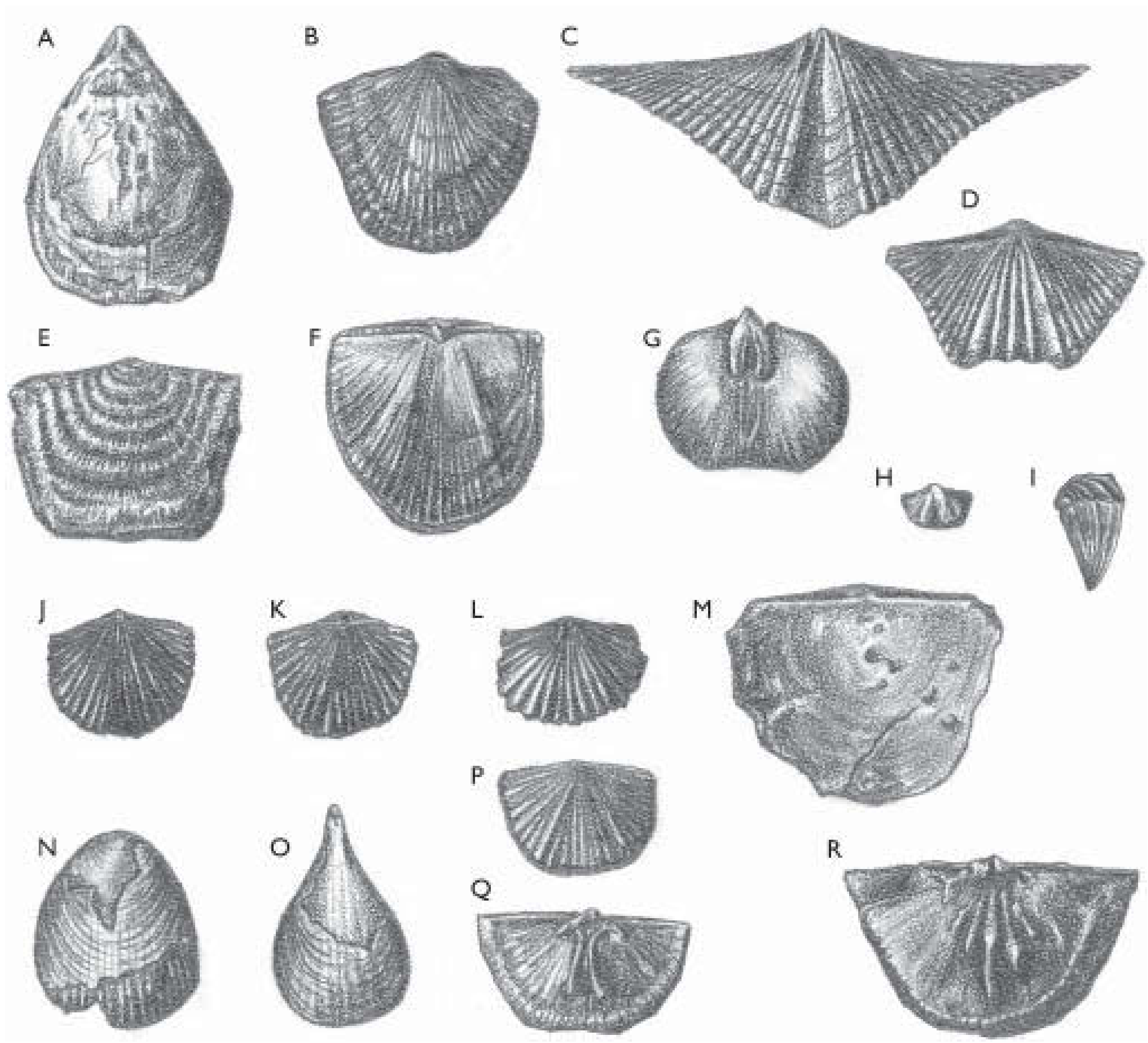


Plate 3. Brachiopod fossils. A: *Westonia*, a raindrop-shaped inarticulate brachiopod found in Cambrian rock [1 cm]. B: *Atrypa*, a common spiriferid brachiopod found in Devonian rock along the margin of Lake Michigan [2.5 cm]. C: *Spirifer*, a Devonian spiriferid brachiopod with wing-like extensions of the shell [6 cm]. D: *Platystrophia*, an Ordovician orthid brachiopod that looks like a spiriferid with a squared front end [3 cm]. E: *Leptaena*, a square-shaped Devonian strophomenid brachiopod that has concentric ridges [2.5 cm]. F: Bottom view of the flat Silurian pentamerid brachiopod *Stricklandinia* [3 cm]. G: A cast of *Orthis*, a rounded orthid brachiopod found in Ordovician rock [2 cm]. H and I: Top and side views of *Cyrtina*, a small spiriferid brachiopod found in Silurian rock [1 cm]. J and K: Pedicle valve and brachial valve views of *Hesperorthis*, an abundant orthid brachiopod in Middle Ordovician rock. It is more egg-shaped than *Eoorthis* (shown on this plate as L) and has a larger interarea [2 cm]. L: Pedicle valve view of *Eoorthis*, an upper Cambrian orthid. It is more square-shaped than *Hesperorthis* and has more pronounced costae than *Billingsella* (shown on this plate as *P*) [1.5 cm]. M: *Protomegastrophia*, a spade-shaped Devonian strophomenid brachiopod that resembles the Ordovician strophomenid brachiopod *Strophomena* (plate 2G), but is more rounded [3.5 cm]. N and O: *Lingulepis*, an inarticulate brachiopod that can be found in Cambrian rock [1.5 cm]. P: *Billingsella*, a square-shaped orthid brachiopod with fine costae that is found in upper Cambrian rock [1 cm]. Q: Interior view of *Sowerbyella*, a common strophomenid brachiopod in Middle Ordovician rock, showing the raised, π-shaped structure near the hinge [1.5 cm]. R: Interior view of *Oepikina*, a Middle Ordovician strophomenid brachiopod, showing strong ridges that diverge from the hinge [2 cm].

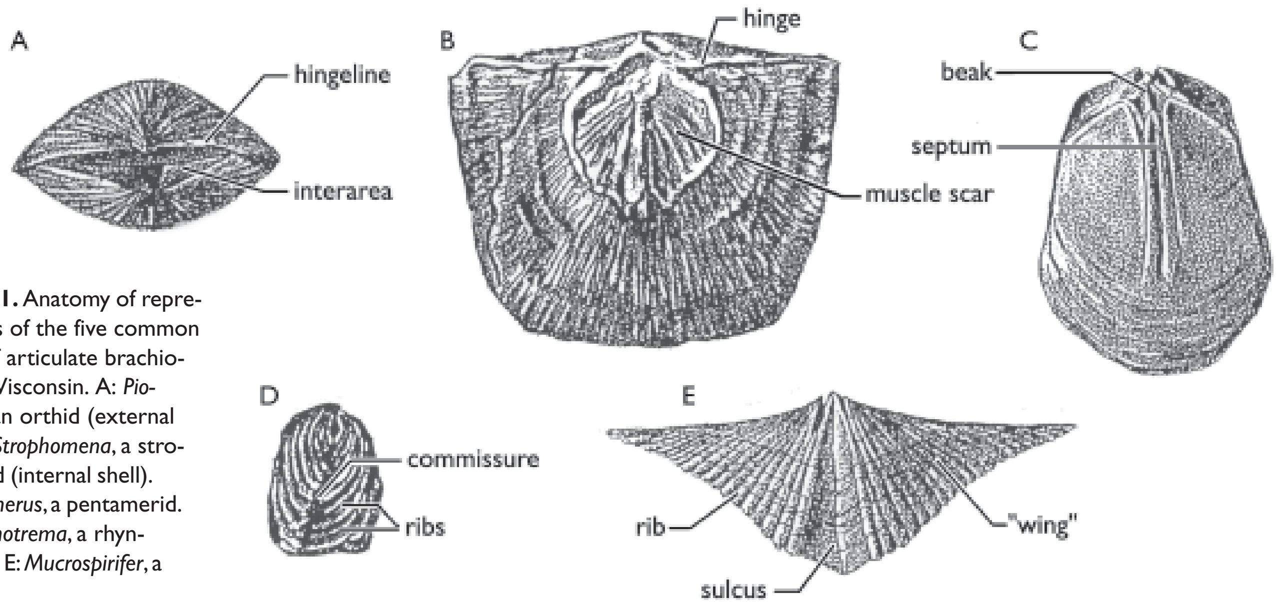


Figure 11. Anatomy of representatives of the five common groups of articulate brachiopods in Wisconsin. A: *Pionodema*, an orthid (external shell). B: *Strophomena*, a strophomenid (internal shell). C: *Pentamerus*, a pentamerid. D: *Rhynchotrema*, a rhynchonellid. E: *Mucrospirifer*, a spiriferid.

posite valve. *Costae* are elevated ribs on the shell. *Growth lines* are concentric rings representing successive periods of growth.

Brachiopods are divided into two main groups: the *articulates* and the *inarticulates*. Articulates have hinge structures on their shells; inarticulates do not. Because articulates greatly outnumber inarticulates in Wisconsin, we focus on the five orders of articulate brachiopods found in Wisconsin: Orthida (orthids), Strophomenida (strophomenids), Pentamerida (pentamerids), Rhynchonellida (rhynchonellids), and Spiriferida (spiriferids).

Orthids

Wisconsin's Ordovician rock holds many orthids (fig. 11A). Several characteristics of orthids distinguish them from other brachiopods. Both valves of orthid shells are convex, and one valve is larger and deeper than the other. Most orthids have costae. The hingeline of the orthid shells is normally straight and somewhat long and is bordered by a large *interarea*, a flat, shelf-like region. Orthids lived from the Cambrian to late Permian, and most Ordovician rock contains diverse assemblages of these brachiopods.

Strophomenids

Strophomenids (fig. 11B) were especially abundant during the Ordovician. Strophomenids usually have large, semicircular shells, with one concave and one convex valve. A short, flat interarea borders the hinge region, and the hingeline is straight, like that of the orthids, but may contain a row of small teeth. Muscle scars are conspicuous features of the internal shell. The strophomenids in Wisconsin, particularly the genus *Strophomena*, commonly cover entire *horizons* (layers) of rock. Strophomenids were devastated along with other groups during the Permian extinction, but managed to survive a little longer, into the Triassic, before becoming extinct.

Pentamerids

Pentamerid shells (fig. 11C) are extremely abundant in the Silurian rock of eastern Wisconsin. These brachiopods are large and egg-shaped, with curved hingelines and pronounced shell beaks. They possess a unique internal structure found near the hinge; it is called the *spondylium*, a raised, spoon-shaped platform used for muscle attachment. Pentamerids arose in the Cambrian, were most common in the Silurian, and became extinct in the Devonian. Some quarries in Dodge County contain Silurian rock with millions of large pentamerid molds and casts.

Rhynchonellids

Most rhynchonellids (fig. 11D) in Wisconsin are small and marble-like in shape. The commissure is zig-zag in outline. These small shells have prominent ribs, and a fold and sulcus are usually present. Rhynchonellids arose in the Ordovician. This group is still present in some of the Earth's oceans.

Spiriferids

Spiriferids (fig. 11E) are among the most beautiful brachiopods. They are somewhat triangular; many possess shell extensions that give them the appearance of having wings. The spiriferids have a unique spiraling support for the lophophore as well as a fold and sulcus. This group arose in the late Ordovician, but can be found mostly in Devonian rock in the Milwaukee metropolitan area. Two main groups of spiriferids are found in Wisconsin: spiriferidinids and atrypids.

Spiriferidinids have straight hingelines and lateral wing-like shell extensions. Some members of this group, such as *Eospirifer*, are superficially similar to pentamerids. *Platyrachella*, because of its interarea, looks suspiciously like an orthid. For the most part, however, triangular-shaped spiriferids are found in Wisconsin.

Atrypids are triangular, and they do not have the wing-like shape of some other spiriferids. These spiriferids have curved hingelines and two convex valves. Most atrypids have ribs and a small beak. *Atrypa* is a common Devonian brachiopod.

Bivalve mollusks: Clams

Bivalves (plate 4) are aquatic mollusks that possess two valves (fig. 12) that protect the soft body parts. The valves are secreted by the *mantle,* a soft tissue that leaves a scar (the *pallial line)* where it connected to the inside of the shell. The muscles that hold the two valves together also leave scars on the inside of the shell, as do the *siphons,* through which food passes in and out of the body. The length and shape of the siphon scar, or *pallial sinus,* is helpful for interpreting the burrowing habits of a bivalve. Different scars are also characteristic of different bivalve species.

Unlike the valves of brachiopods, clam valves are typically of similar size and shape. The two shells are hinged together by a strong ligament. Small teeth and sockets may also be present in the hinge area, which add strength to the hinge and prevent the two valves from slipping apart.

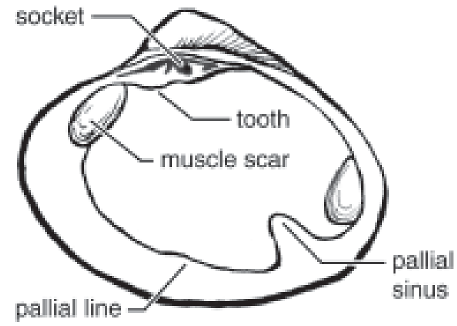


Figure 12. Bivalve mollusk anatomy. Internal view of the right valve of a clam.

Bivalves are filter feeders: They strain small food particles from water. Water enters through the *inhalent siphon,* passes through the gill, which takes in oxygen from the water, and exits through the exhalent, the *outcurrent siphon.* The gill traps food particles and transports them to the mouth. Bivalves live in a variety of habitats: Some live *epifaunally* (on top of seafloor sediment); others live *infaunally* (in seafloor sediment), using their muscular foot to burrow within the bottom sediments. The shape of the shell can be related to the environment in which the animal lives.

Bivalves originated in the Cambrian, but did not become abundant until the Ordovician. They are not particularly common in Paleozoic rock of Wisconsin, but they sometimes can be found within large groupings of other Ordovician fossils.

Gastropod mollusks: Snails

Once confined to the oceans, gastropods (snails; plate 5) now live in streams, lakes, and even on land. Gastropods are the most abundant mollusks: There are approximately 40,000 living species and 50,000 fossil species. Some modern species are voracious predators equipped with poison. However, the snails that lived in Wisconsin's Paleozoic seas were probably peaceful grazers.

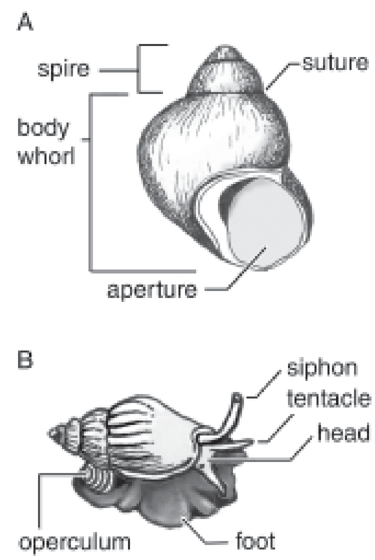


Figure 13. Gastropod mollusk anatomy. A: Apertural view of gastropod shell. B: Anatomy of a living gastropod.

The shell of a gastropod is usually coiled and is used for protection, as it is for most mollusks (fig. 13A). Gastropods can retreat into

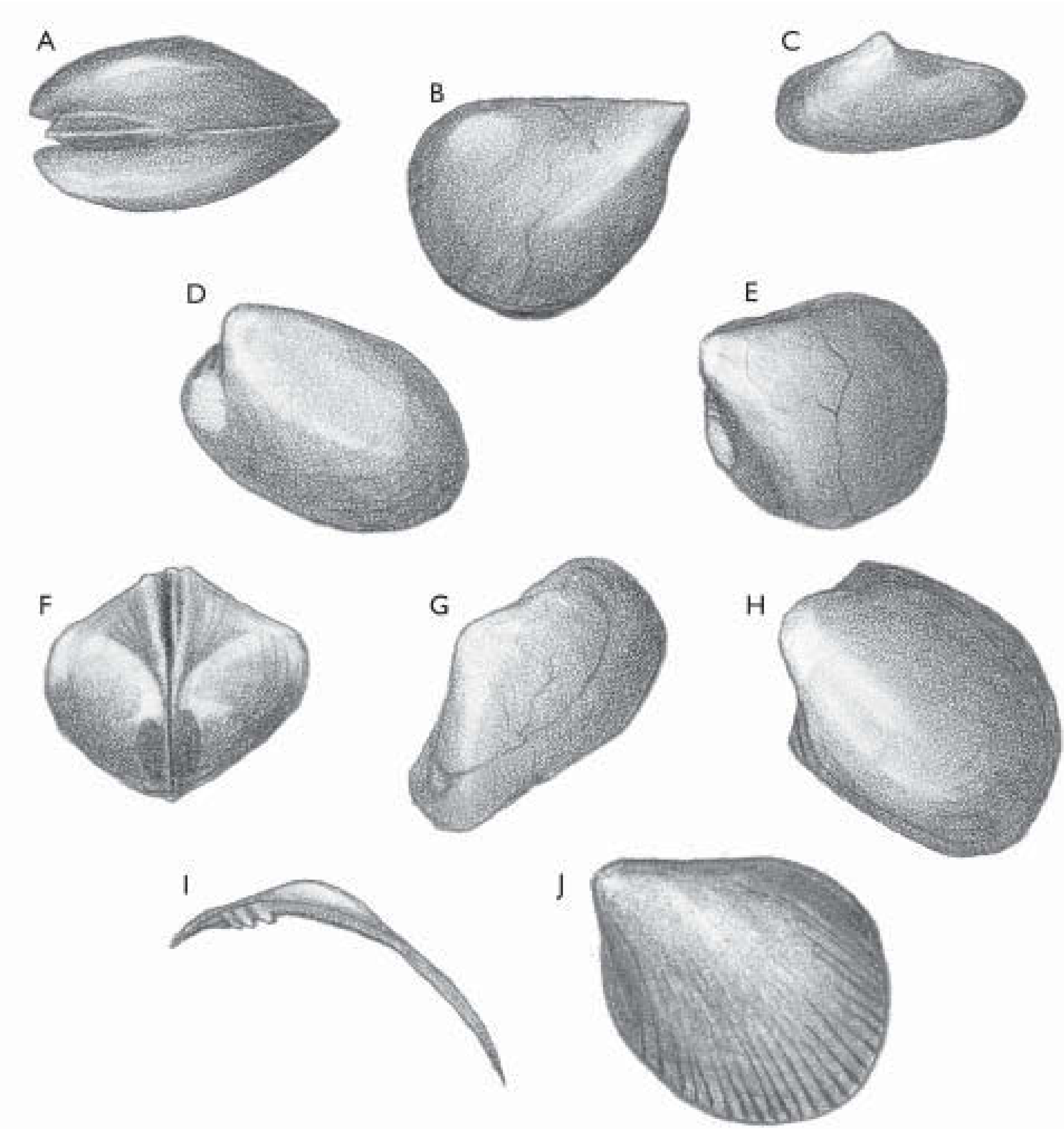


Plate 4. Bivalve mollusk fossils. A: Side view of *Saffordia*, an Ordovician clam [3.5 cm]. B: *Ambonychia*, a raindrop-shaped Ordovician clam [3.5 cm]. C. The elongate Ordovician clam *Ctenodonta* [3.5 cm]. D, E, and F: Two top views and one back view of casts of the egg-shaped Ordovician clam *Cypricardites* [3.5 cm]. G: *Tellinomya*, an Ordovician wedge-shaped clam [3.5 cm]. H and I: Top view of a cast and internal view of the hinge structure of the square-shaped *Cyrtodonta*, a clam found in Ordovician and Silurian rock [4 cm]. J: *Amphicoelia*, a Devonian clam [3.5 cm].

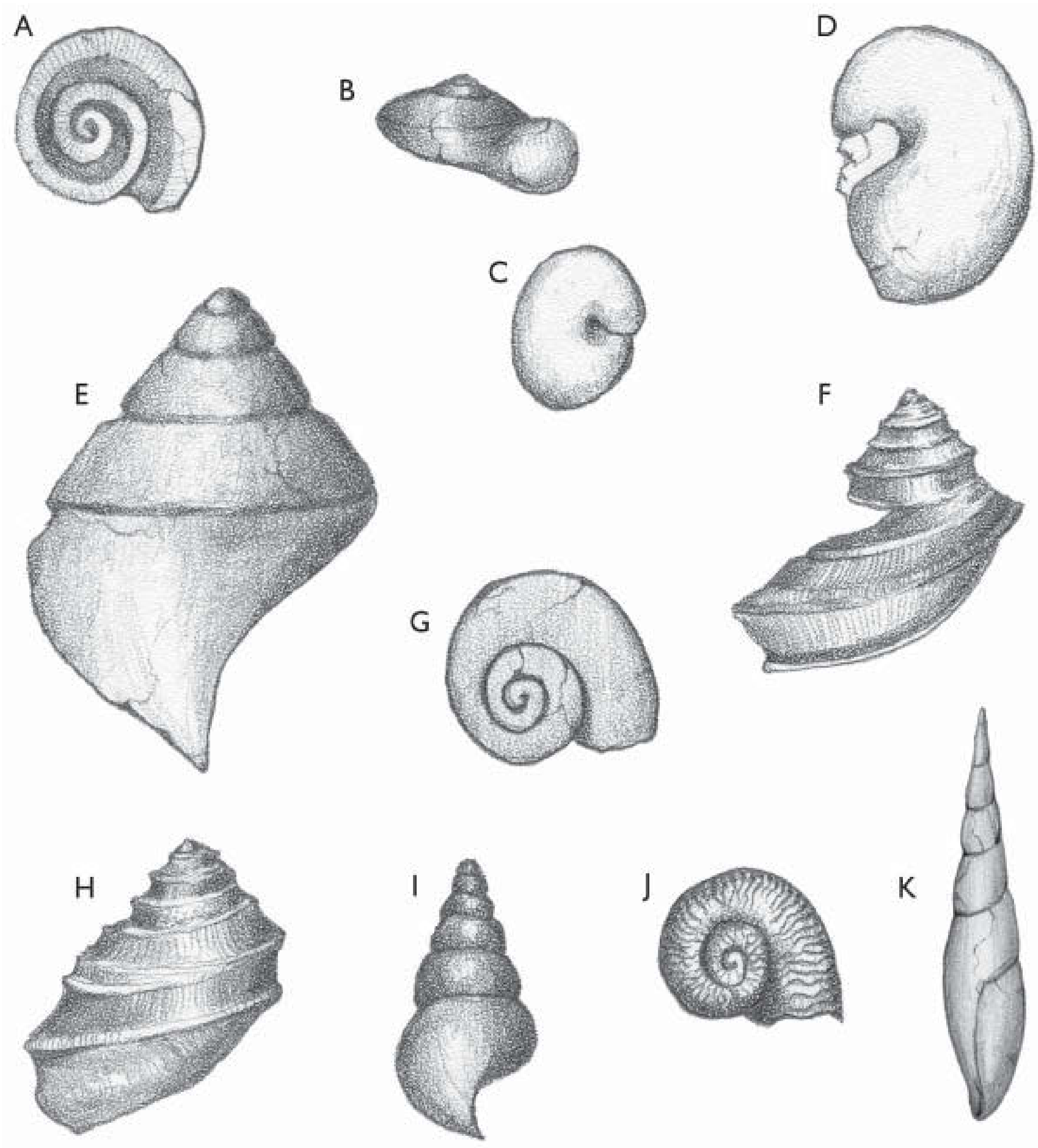


Plate 5. Gastropod mollusk fossils. A: *Helicotoma*, an Ordovician gastropod with raised, angular sutures [2 cm]. B: *Liospira*, an Ordovician gastropod with a flattened shell [1.5 cm]; C and D: *Sinuites*, a common Middle Ordovician gastropod with a large, smooth shell [2.5 cm]. E: *Clathrospira*, a large and common Ordovician gastropod with a cone-shaped spire [4.5 cm]. F: *Lophospira*, a gastropod with angular ridges. It is similar to *Trochonema* (shown on this plate as H), but taller and with an unwound body whorl [4.5 cm]. G: Bottom view of *Maclurites*, an Ordovician gastropod with one side flattened where it rested on the sea floor [4.5 cm]. H: *Trochonema*, an Ordovician gastropod with angular ridges [3.5 cm]. Several different types can be found in Wisconsin. I: *Hormotoma*, a high-spired gastropod found in Ordovician rock [2 cm]. J: *Phragmolites*, an Ordovician gastropod possessing suture-like ornamentation [1.5 cm]. K: *Subulites*, a tall, high-spired Ordovician and Silurian gastropod [5 cm].

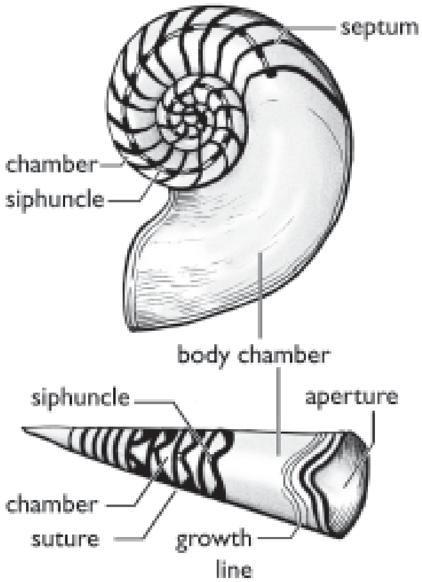


Figure 14. Cephalopod mollusk anatomy: coiled and straight cephalopod shells (after Boardman and others, 1987).

their shells and close the opening with a cover called the *operculum*. The shape of the shell can be highly varied because of the way it coils. Each 360° revolution of the shell is called a *whorl*. The body whorl is the bottom and largest whorl; it contains the *aperture*, the opening of the shell. The shell *spire* includes the whorls above the body whorl. Whorls come in contact with one another at the shell *sutures*.

Gastropods have highly developed sensory organs, including tentacles and eyes (fig. 13B). The head is attached to the foot, a muscular organ used for creeping and feeding. Many gastropods have a *radula*, a rasp-like structure used for scraping algae and other food off the seafloor. Some carnivorous gastropods use the radula for boring through the shells of other animals.

Gastropods originated in the Cambrian, but few are found in rock of that age in Wisconsin; more are found in Silurian and Devonian rock. Our Ordovician rock contains abundant and beautiful gastropod fossils.

Cephalopod mollusks: Squid and octopus

Cephalopods (plate 6) are a group of swimming mollusks, including the living squid, octopus, and the chambered *Nautilus*. Although most living cephalopods have somewhat reduced shells, fossil shells were well developed. Cephalopod shells have evolved into many astonishing and beautiful forms (fig. 14), exhibiting a variety of shapes, such as straight, slightly curved, crescent, and coiled (fig. 15).

The shell of a cephalopod is normally tube- or cone-shaped with many dividers. These dividers are called *septa*, and they partition the inside of the shell into chambers. Each septum intersects the shell wall at a suture, which can be seen as a pattern on the outside of the shell. Sutures are characteristic of cephalopod groups and are therefore helpful for identification. The body chamber, which lacks sutures, is the area where the animal lived. A small tube called the *siphuncle* runs the length of the shell, and passes through the septa. The siphuncle contains liquid that helps maintain the buoyancy of the animal in the water.

Like their clam and snail relatives, cephalopods possess typical molluscan features: a shell, a muscular foot, and a mantle. They also have highly developed sensory organs. The eye of a cephalopod, for example, is similar to that of a human. Unlike the brachiopods and clams, cephalopods are mobile predators, and some can swim at speeds of approximately 64 kilometers (40 miles) per hour by jetting water from the mantle cavity through a fleshy funnel.

Cephalopods originated during the Cambrian and are common as fossils in Ordovician and Silurian rock in Wisconsin. Fossil cephalopods from Wisconsin can exceed 4 meters (13 feet) in length. They are exciting to find because of their large size, but they can be preserved as molds and casts and can be difficult to identify.

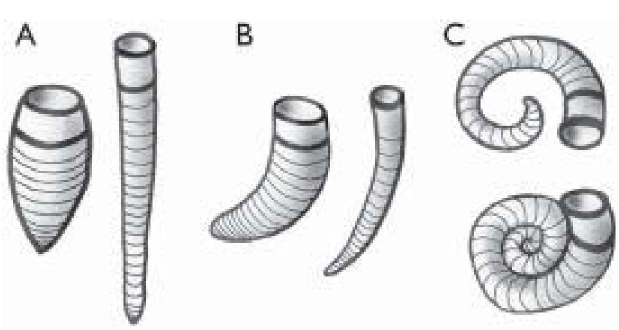


Figure 15. Morphologies of fossil cephalopods.
A: Straight.
B: Crescent-shaped.
C: Coiled.

Extinct arthropods: Trilobites

Trilobites (plates 7 and 8) were a group of crab-like animals with hard *exoskeletons* (outer skeletons) similar to those of modern insects. Trilobites have a three-lobed body (fig. 16B): Two grooves divide the body lengthwise into

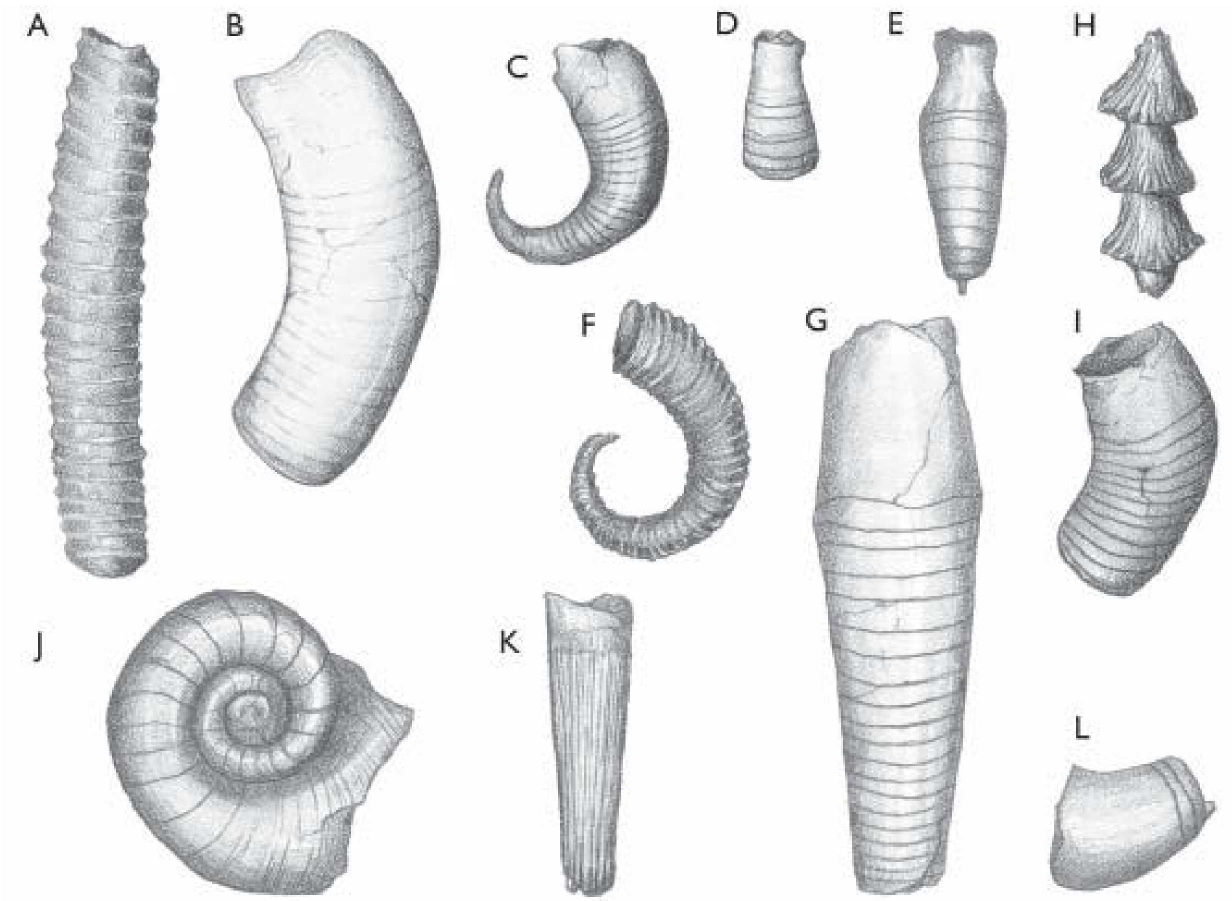


Plate 6. Cephalopod mollusk fossils. A: *Spyroceras*, a common Ordovician and Silurian cephalopod with a straight and ridged shell [10 cm]. B: *Richardsonoceras*, common in Ordovician rock [11 cm]. C: Crescent-shaped *Richardsonoceras*, similar to *Gyroceras*, but lacking a ribbed shell [5.5 cm]. D and E: Two examples of *Whitfieldoceras*, an Ordovician cephalopod with a constricted body chamber [2.5 cm and 5 cm, respectively]. F: *Gyroceras*, a Silurian crescent-shaped cephalopod [6 cm]. G: *Actinoceras*, a large, straight cephalopod common in Ordovician rock [35 cm or more]. H: Enlarged siphuncle of *Actinoceras*, a cephalopod common in Ordovician rock and sometimes found in lower Silurian rock [4.5 cm]. I: *Beloitoceras*, a short and stout Ordovician cephalopod [5 cm]. It is similar to *Richardsonoceras*, but smaller. J: *Trocholites*, a coiled cephalopod occasionally found in Ordovician rock [8.5 cm]. K: *Kionoceras*, a Ordovician cephalopod possessing longitudinal ribs [8.5 cm]. L: *Cyrtorizoceras*, an Ordovician cephalopod possessing a large body chamber [4 cm].

three sections. The middle section is the *axial lobe;* the other two sections are the *pleural lobes.* The body can also be divided into three sections from head to tail: the front section is the head, or *cephalon,* the middle section is the *thorax,* and the tail section is known as the *pygidium.* These marine animals had a series of small, *bilobate*

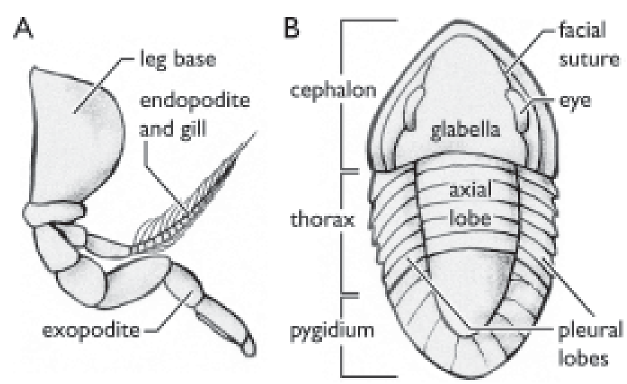


Figure 16. Trilobite anatomy. A: Bilobate appendages of a living arthropod, similar to that of trilobites. B: Exoskeleton of trilobite.

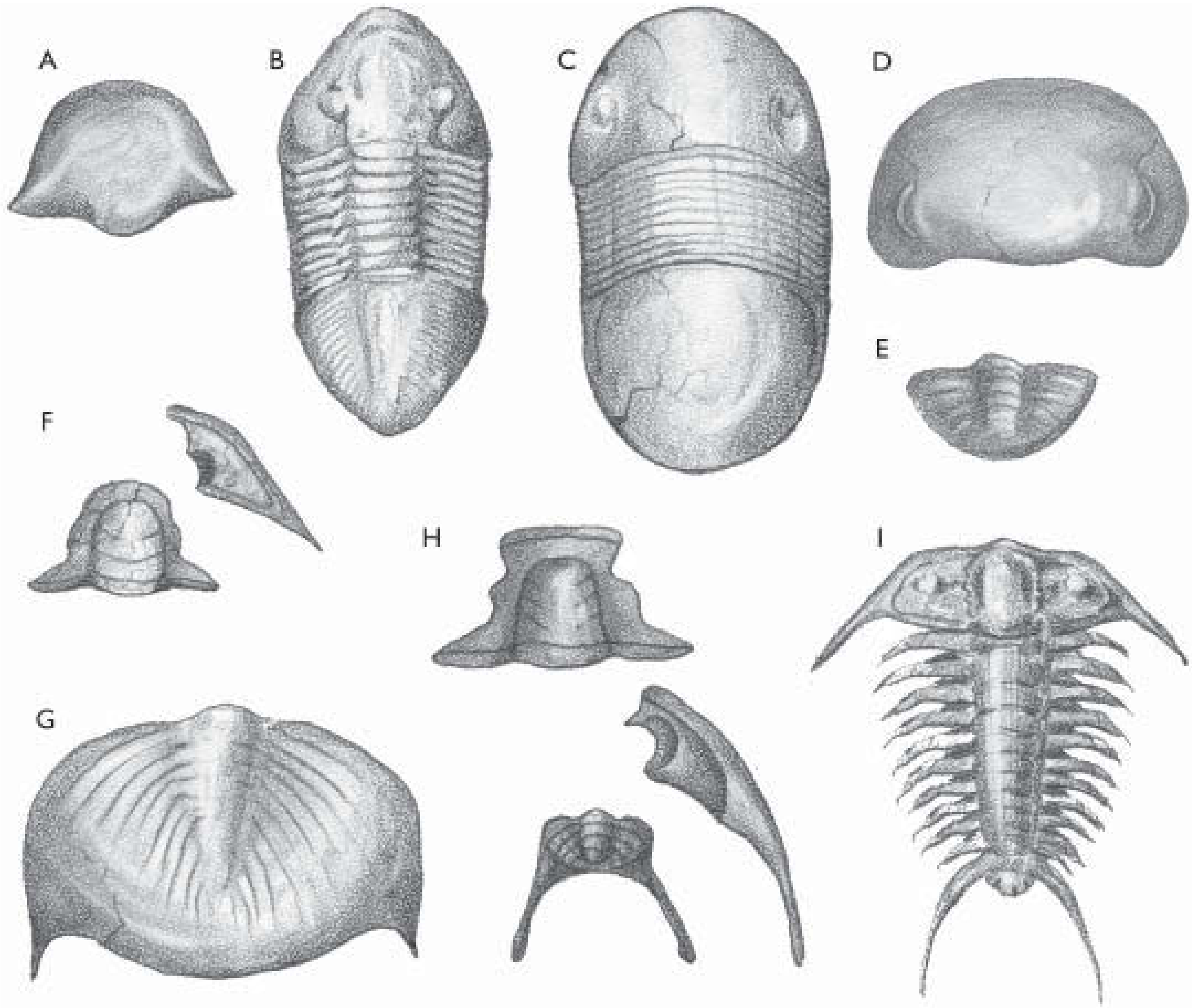


Plate 7. Trilobite fossils. A: Cephalon of *Illaenus*, a common trilobite in Ordovician rock. The cephalon is similar in shape to a strophomenid brachiopod [2.5 cm]. B: Complete specimen of the Ordovician trilobite *Isotelus*. It has a more triangular cephalon and pygidium than *Bumastus*, and a more pronounced axial lobe [5 cm]. C: *Bumastus*, a Ordovician mud-burrowing trilobite with a broad, rounded cephalon and pygidium [6.5 cm] D: Large cephalon of *Bumastus* [4 cm]. E and F: Stubby, rounded pygidium and disarticulated cephalon of the Cambrian trilobite *Conaspis*. The glabella is more rounded than that of *Crepicephalus* (shown on this plate as H) [3 cm]. G: Large, egg-shaped pygidium of the upper Cambrian trilobite *Dikelocephalus* [6 cm]. The pygidium looks similar to a fish tail. H: Molted parts of the Cambrian trilobite *Crepicephalus*. The glabella is more squared than that of *Conaspis*. Extensions of the pygidium make it look similar to a swallowtail butterfly wing [3 cm]. I: The Ordovician trilobite *Ceraurus*, showing the characteristic tail spines and pronounced "ribs" of the pleural lobes [4 cm].

(two-pronged) legs beneath their exoskeleton (fig. 16A). One part of the leg, the *exopodite,* was used for walking; the other, the *endopodite,* was used for gas exchange or "breathing."

On the cephalon, a series of lines, or *facial sutures,* are present. These sutures opened when trilobites molted their skeletons. The trilobite pushed itself out of its old skeleton and grew a new one; most trilobite fossils are *instars,* or molted skeletons. The region of the cephalon between the eyes and bounded by the sutures is called the *glabella*.

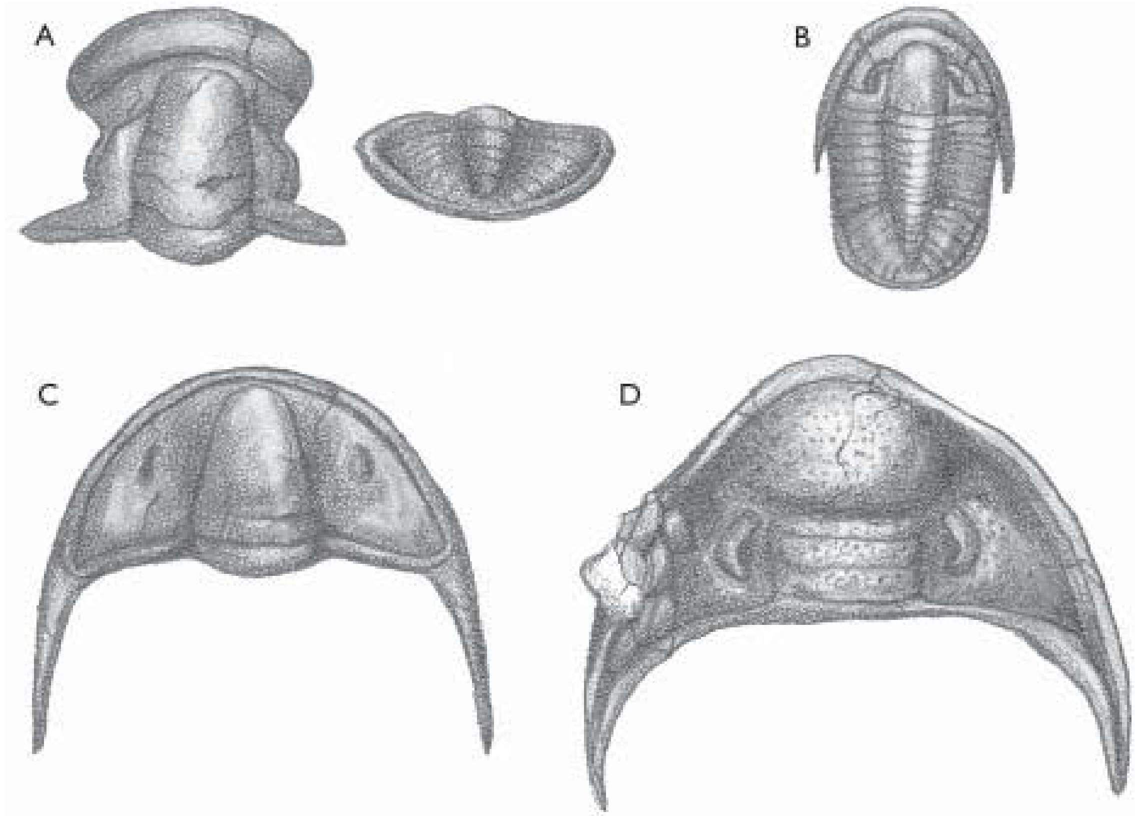


Plate 8. Trilobite fossils. A: Cephalon and pygidium of the Cambrian trilobite *Wilburnia*. The glabella is similar to that of *Conaspis* (shown on plate 7 as F), but with a pronounced flared lip along the outer margin [1.5 cm]. B: Articulated specimen of *Cedaria*, found in Cambrian rock. It is similar to *Wilburnia*, but smaller and with a narrower pygidium and lip [3 cm]. C: Cephalon of *Ptychaspis*, a Cambrian trilobite. It is similar to *Cedaria*, but much larger and with more widely spaced eyes [3 cm]. D: *Dalmanites*, a Silurian trilobite possessing bumps on the cephalon [4.5 cm].

Trilobites had compound eyes, much like those of insects. Some trilobites were adapted to mud-burrowing, and possessed *vestigial,* or nonfunctional, eyes. Mud-burrowing trilobites had smooth, streamlined bodies.

Trilobites first appeared in the Cambrian, but after a diversification they dwindled and eventually became extinct during the Permian. Trilobite fossils are not common in Wisconsin. Generally, they form a large component of Cambrian fossil assemblages, and Ordovician rock commonly contains trilobite fragments. In Silurian rock, trilobites may be associated with reef-like habitats. Devonian trilobites are not particularly abundant. Fossil tracks of trilobites can be found on rock that was once the Paleozoic seafloor. The trilobite *Calymene celebra* is Wisconsin's state fossil.

Crinoids: Sea lilies

Crinoids (plate 9A, B) are echinoderms, a group that includes the starfish, sea urchins, and sand dollars. Sometimes called sea lilies, crinoids resemble long-stemmed flowers, but they are marine animals. A *holdfast* at the base of the animal's stem functions like a root that holds the animal in place (fig. 17). The animal's cuplike body, or *calyx,* is composed of a mosaic of geometric plates. The calyx has many arms that open into a fan-like net so the crinoid can feed on microscopic food particles. The flexible stem is

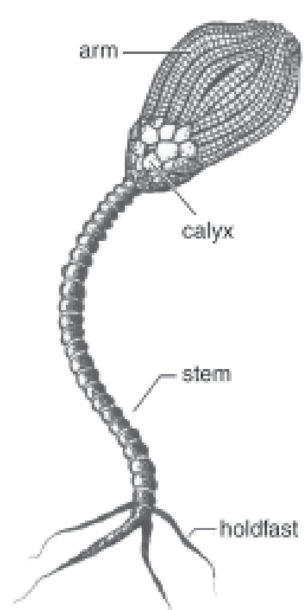


Figure 17. Crinoid anatomy.

composed of a series of button-like discs called *columnals.* When crinoids die, their stems fall apart, or *disarticulate,* into columnals. The *lumen,* a hole in the middle of the stem, contained a tube for carrying nutrients to the stem and holdfast. The mouth of the crinoid is on the top of the calyx.

Crinoids first appeared in the Cambrian and diversified until the Permian extinction, when their numbers were greatly reduced. Complete crinoid fossils may occasionally be found in Wisconsin's Silurian and Devonian rock, but most crinoid fossils consist of scattered columnals. In the Paleozoic, crinoids lived in colonies in shallow waters, but today they live in deeper regions of the world's oceans.

Bryozoans: Moss animals

Bryozoans (plate 9C, D) are small, mostly marine animals that form skeletons of a variety of shapes: tiny twigs, nets, domes, and mossy crusts (fig. 18). The *zooecium* (skeleton) houses highly structured colonies of *zooids,* or cuplike animals. Bryozoans, like brachiopods, contain a tentacle-bearing lophophore used in feeding

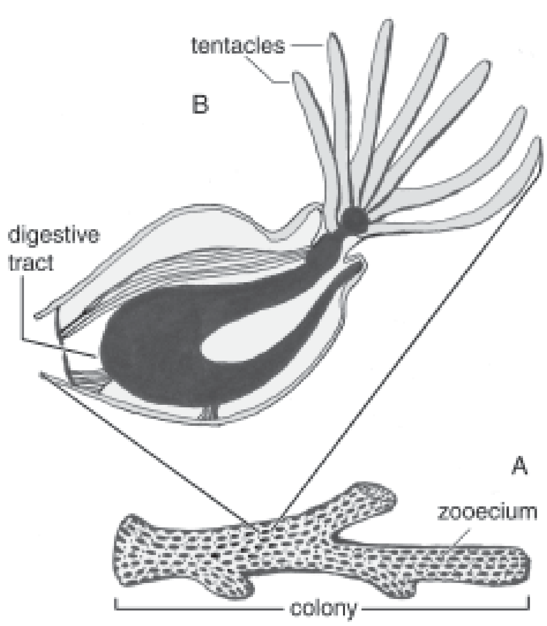


Figure 18. Bryozoan anatomy. A: Skeleton of a bryozoan colony. B: A zooid living in the skeleton.

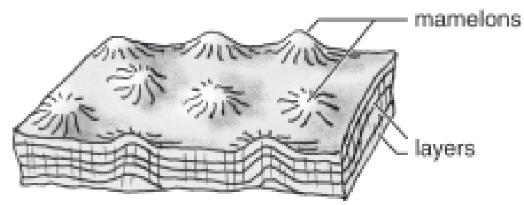


Figure 19. Stromatoporoid anatomy.

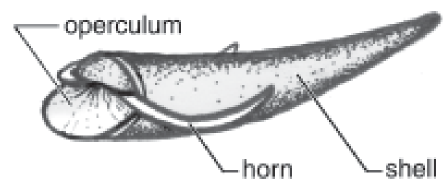


Figure 20. Hyolithid anatomy.

and gas exchange. They also contain a u-shaped gut with a distinct mouth and anus.

Bryozoans are inconspicuous fossils, but can be seen most easily on slabs of Ordovician limestone or dolomite with the aid of a magnifying glass or hand lens. Bryozoans are difficult to distinguish from one another. In most cases you may not be able to identify your fossil more specifically than as a bryozoan.

Bryozoans were able to live almost anywhere: on a brachiopod shell, the side of a cephalopod, coating sea plants, or in an individual colony on the sea floor. Many fossils have patches of bryozoans on them. Bryozoans first evolved in the Ordovician and have persisted to the present day; they live in ocean habitats that are similar to those of Paleozoic seas.

Other fossils

Stromatoporoids: Laminated reef builders

Stromatoporoids were colonial marine organisms related to sponges. They formed skeletons composed of thin layers called *laminae*. Small bumps called *mamelons* were present on their surface (fig. 19). Stromatoporoids formed reefs in the shallow Silurian seas of Wisconsin. They became extinct 65 million years ago.

Ostracods: Bivalved arthropods

Ostracods (plate 9E) are small, two-valved arthropods that resemble small, dark, polished

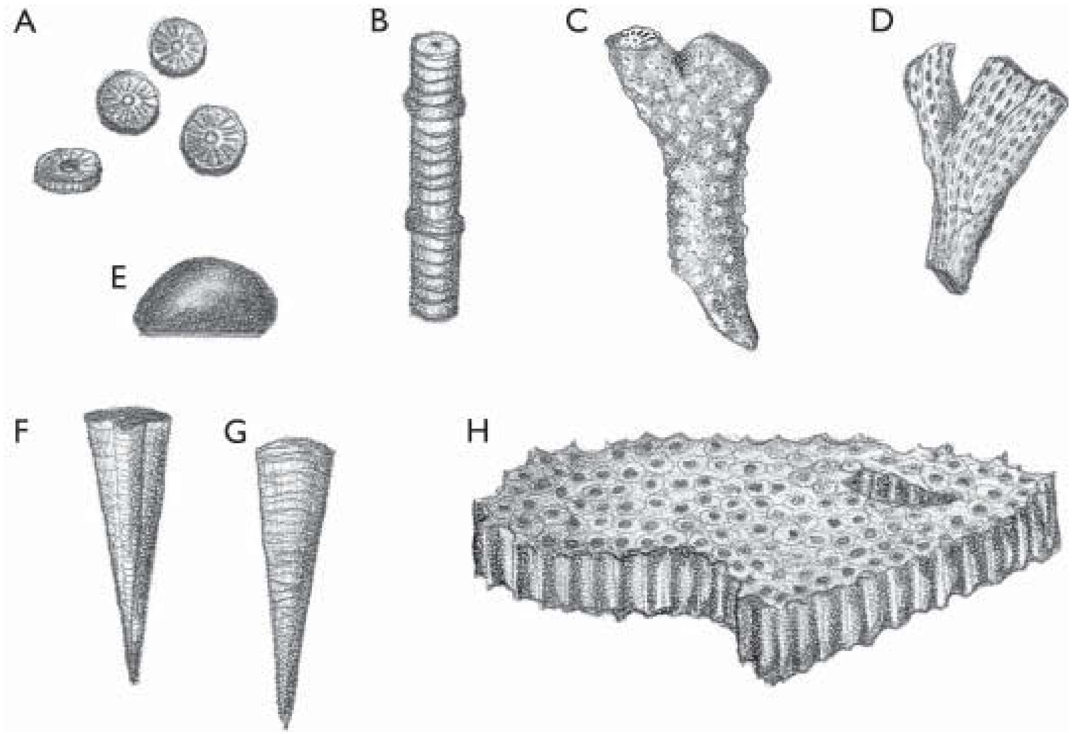


Plate 9. Miscellaneous fossils. A: Crinoid columnals, or plates, which make up the stems [0.5 cm]. B: Crinoid column section, or stem [3.5 cm]. C and D: Fragments of bryozoan colonies found in Ordovician, Silurian, and Devonian rock [3 cm]. E: *Eoleperditia*, an Ordovician ostracod. [1 cm]. F and G: Two views of the Ordovician hyolithid *Hyolithes* [3 cm]. H: An Ordovician colony of *Receptaculites*, believed to be a skeleton-secreting algae [10 cm].

beans. Ostracods first appeared in the Cambrian and still exist today in freshwater, marine, and terrestrial environments. Like other arthropods, ostracods molt their skeletons as they grow. Although they are not very common, ostracods are occasionally found in Wisconsin's Ordovician and Silurian rock.

Hyolithids: Animals of unknown affinities

Very little is known about these mysterious animals. Hyolithids (plate 9F, G) are an unusual, extinct group of marine animals that had a conical shell with an operculum (fig. 20). They are sometimes found in the digestive tracts of fossil marine worms. Middle Ordovician rock in Wisconsin commonly contains hyolithids.

Receptaculitids: Skeleton-secreting algae

Receptaculitids (plate 9H) are another extinct group of marine organisms that scientists have had difficulty classifying. Receptaculitids have been classified as corals and sponges, but they are now thought to be colonial algae. They superficially resemble favositids, the honeycomb corals. Receptaculitid fossils are most common in Ordovician rock.

Trace fossils: Trails, borings, and burrows

Trace fossils (plate 10) are the preserved paths of animals that crawled on and bored or burrowed into the seafloor. A variety of paths representing behaviors—such as feeding, moving, and resting—can be found in sedimentary rock. Certain burrowing behaviors are specific to certain environments, so paleontologists can reconstruct ancient environments from the shape of trace fossils. Trace fossils are common in the Paleozoic rock of Wisconsin and are still being formed in ocean sediments today.

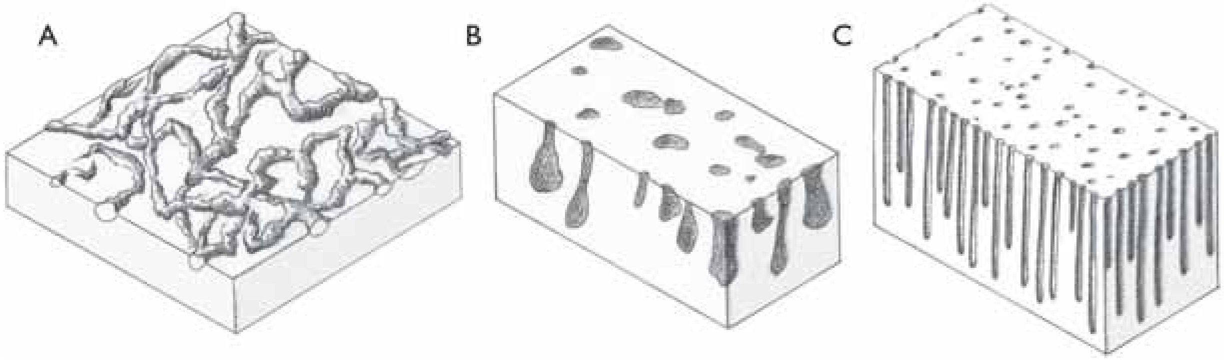


Plate 10. Trace fossils. A: Large, worm-like feeding traces parallel to rock layers [diameter can be as much as 1 cm]. B: Large, variably shaped borings perpendicular to rock layers [diameter up to 1 cm or more; length up to 4 cm or more]. C: Long, thin burrows perpendicular to rock layers [diameter less than 0.5 cm; length up to 5 cm or more].

Sources of information

Societies

Wisconsin abounds in groups that are devoted to all aspects of the earth sciences, including paleontology. One way to find out if there is a club near you is to check with the Midwest Federation of Mineralogical and Geological Societies, a regional member of the American Federation of Mineralogical Societies. The Midwest Federation maintains a directory of its member societies. (Note that not all of these societies focus on paleontology.) The Internet address for the Midwest Federation at the time of the printing of this publication is **<www.amfed.org/mwf/>.**

One of the largest groups in Wisconsin is the Wisconsin Geological Society. It is a nonprofit organization, located in Milwaukee, that conducts study groups, meetings, and field trips on geology and paleontology. Its monthly publication, *The Trilobite*, contains articles of local interest on rocks, minerals, and fossils. This group is an excellent place to learn more about fossils and geology and meet others interested in Earth history.

Books

You may be interested in learning about fossils in more detail. Many books have been written for the interested layperson; check your local public library for the various titles available. The following books provide detailed technical information about fossils and the principles of paleontology. They are usually available at university libraries.

Boardman, R.S., Cheetham, A.H., and Rowell, A.J., 1987, *Fossil Invertebrates:* Blackwell Scientific Publications, Palo Alto, 713 p.
A detailed, college-level textbook intended for paleontology students.

Chamberlin, T.C., 1882, *Geology of Wisconsin: Survey of 1873–1879*, Volume IV, 779 p.
A classic work on the geology and paleontology of Wisconsin.

Easton, W.H., 1960, *Invertebrate Paleontology:* Harper and Row, New York, 701 p.
A detailed and extensively illustrated college-level textbook.

Moore, R.C. (director and editor), 1953—, *Treatise on Invertebrate Paleontology*: The University of Kansas Press/The Geological Society of America.
A multi-volume, professional-level treatise containing every described fossil genus.

Moore, R.C., Lalicker, C.G., and Fischer, A.G., 1952, *Invertebrate Fossils:* McGraw–Hill Book Company, Inc., New York, 766 p.
A general text on invertebrate fossils.

Rhodes, F.H.T., Zim, H.S., and Shaffer, P.R., 1962, *Fossils:* Western Publishing Company, Inc., Racine, 160 p.
An inexpensive, superbly written, and extensively illustrated book.

Schrock, R.R., and Twenhofel, W.H., 1923, *Principles of Invertebrate Paleontology:* McGraw-Hill Book Company, Inc., 816 p.
A classic text written by Wisconsin paleontologists.

Shimer, H.H., and Schrock, R.R., 1945, *Index Fossils of North America:* John Wiley & Sons, New York, 837 p.
A book that will help you identify fossils not illustrated in this guide.

Acknowledgments

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Reconstruction of Silurian reef. (Photograph of diorama © Milwaukee Public Museum.)

Eon	Era	Period	Million years ago	Notes
Phanerozoic	Cenozoic	Quaternary	0–2	
Phanerozoic	Cenozoic	Tertiary	2–66	
Phanerozoic	Mesozoic	Cretaceous	66–144	
Phanerozoic	Mesozoic	Jurassic	144–208	
Phanerozoic	Mesozoic	Triassic	208–245	
Phanerozoic	Paleozoic	Permian	245–286	
Phanerozoic	Paleozoic	Pennsylvanian	286–320	
Phanerozoic	Paleozoic	Mississippian	320–360	
Phanerozoic	Paleozoic	Devonian	360–408	Extensive sea present. Fishes become abundant; some invertebrate animals develop spines and boney frills on shells. Trilobites and pentamerid brachiopods decline; coral reefs diminsh. Crinoids and spiriferid brachiopods are common.
Phanerozoic	Paleozoic	Silurian	408–438	Plants and animals invade land. Tabulate and rugose coral reefs are extensive; they are covered with crinoids, bryozoans, and pentamerid brachiopods. (See reef reconstruction, above.)
Phanerozoic	Paleozoic	Ordovician	438–505	Sea level rises and falls several times. New animal groups (bryozoans and corals) appear. Mollusks and strophomenids and orthid brachiopods dominate shallows; trilobites become less common.
Phanerozoic	Paleozoic	Cambrian	505–570	Much of what is now the United States is covered by water. Many groups of marine animals, such as trilobites, mollusks, crinoids, and inarticulate brachiopods, appear.
"Precambrian"	Proterozoic	Soft-bodied organisms (single and multi-celled) develop; first invertebrates appear.	570–900–1,600–2,500	
"Precambrian"	Archean	Oldest known fossils: bacteria and single-celled organisms.	2,500–3,000–3,400–3,800-4,400	

Geologic time scale. Shaded area indicates time periods for which there is only sparse evidence in Wisconsin.

E.S. 45

Common Paleozoic Fossils of Wisconsin

2002

UW Extension

Wisconsin Geological and Natural History Survey
3817 Mineral Point Road • Madison, WI 53705-5100
TEL: 608/263.7389 FAX: 608/262.8086 www.uwex.edu/wgnhs/
James M. Robertson, *Director and State Geologist*

Lesson Plan for People of the Waters Exhibit: Journey through Time
Timeline Case

Lesson Name: **Observe and Explain**

Grade: **High School**

Subject Area(s): **Social Studies**

Objectives: In this exploration, students will observe and analyze artifacts made and used in this region on display in the *People of the Waters* artifact timeline case in order to create claims, based on evidence, about how these cultures viewed the world. Students will learn about a culture through the materials they created or used and interpret beliefs through the artifacts they select.

Standards Addressed:
Social Studies
History: B.12.3, B.12.5, B12.12
Behavioral Science: E.12.5, E.12.14

Materials:

- Handout: *Observe and Explain*

Activity:

1. Each student will select four different artifacts that are on display in the artifact timeline. They will use the provided handout to answer the questions and present their findings to the class.

2. Extension Activities: For homework, students could construct a poster/collage comparing the kinds of artifacts used by the Native Americans in the past and people today. Can you find a parallel?

Handout: Observe and Explain

Artifact 1

Name and description (draw an image if it helps):

What materials were used to make this artifact? How was it created?

Why was this artifact created? How was it used?

When and where was this artifact created?

Can you describe something similar that is used by you or in present time?

Handout: Observe and Explain

Artifact 2

Name and description (draw an image if it helps):

What materials were used to make this artifact? How was it created?

Why was this artifact created? How was it used?

When and where was this artifact created?

Can you describe something similar that is used by you or in present time?

Handout: Observe and Explain

Artifact 3

Name and description (draw an image if it helps):

What materials were used to make this artifact? How was it created?

Why was this artifact created? How was it used?

When and where was this artifact created?

Can you describe something similar that is used by you or in present time?

Handout: Observe and Explain

Artifact 4

Name and description (draw an image if it helps):

What materials were used to make this artifact? How was it created?

Why was this artifact created? How was it used?

When and where was this artifact created?

Can you describe something similar that is used by you or in present time?

Lesson Plan for People of the Waters Exhibit: Early People
Archaeology

Lesson Name: **Let's Talk Trash**

Grade: **High School**

Subject Area(s): **Social Studies, English Language Arts, Science**

Objectives: Students will be able to learn and understand how archaeologists answer questions about a culture by studying the things people used and discarded. Students will learn how archaeologists use, categorize and interpret discarded material as evidence to theorize and reconstruct how people lived in the past. Using the modified lesson, students will be learn to distinguish observations from inferences and better understand the archaeological material and concepts that are displayed in the exhibition *People of the Waters*.

Standards Addressed:
- Social Studies
  - History: B12.12
  - Behavioral Science: E.12.5, E.12.14
- English Language Arts
  - Science: SCI.ELA.W1
  - Social Studies: SS.ELA.W2, SS.ELA.W9
- Science
  - Science Connections: A.12.4, A.12.7
  - Science Inquiry: C.12.5, C.12.6

Activity: *Trash Talks*
Modified from the Archaeological Institute of America Education Department
Original Lesson Plan by Shelby Brown

Goals: Students can interpret modern trash to learn about people today in the same way archaeologists use ancient garbage as evidence for people's lives in the past. Students will learn that:

- Archaeologists answer questions about a culture by studying the things people used and discarded
- Categorizing helps historians and archaeologists interpret evidence
- Observations (what we can see) are different from inferences (stories we tell)
- Scholars build upon initial facts and solve problems working together

Ideally, students will conclude by summarizing questions still unanswered by their data—questions that will require further research or excavation. For younger students the selection of trash can be kept simple; for older students the trash can be more complex, from multiple rooms and more people, and can leave more questions unanswered. Teachers can also start with simplified trash collections and work to more complex.

Cultural/Historical Context: The science of archaeology includes the study of people's trash! Excavators often recover sherds (broken pottery fragments), pits, seeds, and bones left from meals, old tools, and lost or discarded objects of all kinds. Sometimes these items were intentionally thrown out and are found in trash pits, old wells, and dumps. At other times objects were simply lost or discarded wherever the ancient owner happened to be. It is not as common as one would like for archaeologists to find beautiful, well crafted, whole objects; their discoveries are often the broken bits and pieces of everyday life that people threw out or abandoned.

Trash can supply many useful clues that archaeologists may use to reconstruct the way people lived in the past. When considered together with associated artifacts from the same time and place, trash can tell us about site population, occupations, activities, diet, travel and trade routes, the environment, and much more.

Required Materials, Tools, and Preparation:

1. The teacher should collect trash or manufacture it to suit a story s/he has in mind, compiling enough trash for all the groups of students to analyze. The collection needs to be carefully monitored to avoid saving anything that is wet, unsafe, or unsanitary (e.g., used tissue or dental floss, sharp cans or broken glass, food remains that could become spoiled).
2. If brought from home or an office, the trash will ideally be from several different rooms (kitchen, bedroom; photocopy room, reception area, office. This diversity of remains allows students to infer what areas it came from, how many people were living in the house or working when the trash was collected, what their ages and functions were, and what they were doing.
3. If the trash is from school, it should come from several different classrooms, permitting conclusions to be drawn about subjects taught and whether adults and children (or both) produced the trash. Trash from different rooms should not be mixed. The teacher may also design a scenario, such as a birthday party for two different children of different genders and ages.

The Classroom Process:
The trash from different rooms may be kept separate for easier analysis, with the goal being for students to identify the function of a room as well as anything that can be inferred about its users. The organized trash mirrors the artifacts an archaeologist might find while carefully excavating the different rooms of a house. For a more challenging project, combine all the trash from different rooms and then divide it into several bags. This trash might mirror the discarded finds all mixed together in an ancient pit or dump. A teacher-designed scenario could be presented in either way (in separate containers of trash from different activity areas, or in containers of trash all mixed together from all areas).

Since professional archaeology is a group activity, having students work in teams makes the analysis more realistic as well as more fun. Different student groups should be assigned the job of becoming experts in particular bags of trash. First they should categorize the objects to start to gain control over the mess. They may change their minds about how to categorize as they proceed. They should then write down their observations and – separately – the inferences they draw from them. Separating observations from inferences can be difficult for students and adults alike, and should be a high priority. Depending on the nature of the trash or garbage collected (from a kitchen, for example), students might also consider what has been left out for reasons of sanitation, and guess what the missing food might tell about our culture or about a kitchen's users.

Instructions for Students:

1. Divide the class into small groups of 4-6 students. Give a bag of trash to each group. You may give students rubber gloves if you wish. Each group of students should be instructed to sort the trash into categories. Many different categories are possible, for example:

   - Material: plastic, paper, metal
   - Color: red, white, multi-colored
   - Type: food items, tools, sports equipment
   - Theme: food-related items, tools
   - Combinations of the above: plastic tools and food containers.

2. The point of categorizing is to make order out of a jumble of materials. Students may change their minds about their categories and, if so, should discuss why categorizing was difficult and why they changed their minds.

3. The compiled data should be considered as the foundation from which students put together their observations and make interpretations about the people who left the trash. Teachers should first discuss the difference between observations and inferences. Explain that students will put their observations together with their knowledge of modern society to draw reasonable inferences and answer specific questions. The teacher should develop the questions in part based on the trash collected.

   Questions can include:
   - Who were the people who discarded the trash?
   - How many people were there?
   - What were they doing?
   - What time of year was it?
   - How old were they?
   - What gender were they?
   - How many inferences are based on cultural assumptions that could be incorrect? (For example, does pink always = female?)
   - What might be missing from the trash, and why?

4. When the teacher is satisfied that each group has organized its finds, made reasonable observations, and come to some logical inferences, the groups should come together to present their findings.

   Each group should:
   - Explain how categorizing helped them organize the collection of objects
   - Summarize their observations
   - Present their inferences

The end of an archaeological project requires that the investigators think again about what they have found and have NOT found. After the groups have presented their individual conclusions, ask the students to put all the clues from the entire assemblage together and try again to interpret the trash. Are there any additional material remains they would expect (or hope) to find if this were a real dig site and they continued excavating, or that other archaeologists might uncover at similar sites? Students should reach a clearer and fuller understanding of the people who left the trash when they consider all of it together rather than in isolation.

If the trash assemblage has been partially manufactured by the teacher with a story in mind, as a finale tell the students what the actual story is behind the trash they have been analyzing. On a real excavation, there would be no one to tell the story unless the archaeologist found an explanatory text buried with the trash!

Assessment: The assessment should allow for mistakes. The highest credit should be given for careful observation and helpful teamwork. The ability to distinguish observations from inferences and the realization that there can be several explanations for some data are worth rewarding.

Lesson Plan for People of the Waters Exhibit: Early People
Longhouse

Lesson Name: **Oneota Presentation**

Grade: **High School**

Subject Area(s): **Social Studies, English Language Arts**

Objectives: Students will learn what life was like for Wisconsin's Oneota people. Students will conduct research to create a poster or digital presentation showing the life of an Oneota person.

Standards Addressed:
- Social Studies
  - History: B.12.1
- English Language Arts
  - Writing: ELA.W2, ELA.W7

Materials:
- *People of the Waters* Virtual Exhibition (oshkoshmuseum.org)
- Computer with Internet access
- Poster board or digital presentation program (power point, prezi)

Activity:
1. Let students explore the Oneota longhouse and artifacts in the exhibit. Have students research online what life was like for the Oneota. Virtual Exhibit shows all of the artifacts in the timeline case. www.oshkoshmuseum.org
2. Have students create a poster or digital presentation showing what their life would have been like as an Oneota. It should show where they lived in Wisconsin, what they did to survive, their food and shelter, items they used and created, social interactions, and how they were entertained. Have the students give a presentation to the class.

Extension activity: Have the students write a report on how they researched. What kind of evidence did they find to support their presentation? What kind of evidence is missing? What do archaeologists think are the origins of the Oneota? What do archaeologists think happened to them?

Lesson Plan for People of the Waters Exhibit: Early People
Natural Resources

Lesson Name: **Natural Resource Report**

Grade: **High School**

Subject Area(s): **Science Social Studies**

Objectives: Students will learn about the natural resources of Wisconsin and its relationship with American Indians. Students will conduct a research project on ways in which American Indians have used local resources in the past, how European arrival disrupted that use, and how they adapted using natural resources today.

Standards Addressed:
- Social Studies
  - Geography: A.12.12, A.12.13
- Science
  - Environmental Education: B.12.9, B.12.16
  - Science Inquiry: C.12.3

Materials:
- Paper
- Computers

Activity:
1. Students will observe the *People of the Waters* gallery and select a natural resource to research. Examples include types of animals, food, water sources, trees, and soil.
2. Students will learn from the exhibit how early American Indians used the natural resource. Have students conduct additional research on early use, how European arrival disrupted that use, and how they adapted their practices for modern day.
3. Students will produce a report or presentation on their research. Example of questions they should answer:
    - How did early American Indians use the natural resource?
    - What were some advantages or disadvantages American Indians had in using their resources pre-contact?
    - How did their natural resource use conflict with arriving Europeans?
    - What was the result of the conflict with Europeans?
    - How did American Indians adapt to those changes in resource use?
    - How do both parties view natural resource ownership?
    - How has evolving technology influence their use?
    - How do American Indians use natural resources today? Are there advantages or disadvantages compared to past use?

Lesson Plan for People of the Waters Exhibit: Travel and Trade
Discussion Questions

Lesson Name: **The Value of Trade**
Adapted from the Glenbow Museum Teacher Resource for "Fur Trade: Shaping an Identity"

Grade: **Elementary, Middle, and/or High School**

The exhibits in the Travel and Trade section (including the object timeline section "Fur Trade") explore the time in history before, during, and after the Fur Trade through the examination of artifacts. Students will utilize interactive elements in the exhibition *People of the Waters* to explore trade activities. One interactive display entitled "Native Trade Routes" allows students to see how and where materials traveled to/from Wisconsin. The second interactive display is a trade game entitled "Let's Make a Trade!" that allows students to participate in a digital game of how American Indians and Europeans traded goods and the value placed on those goods.

These Pre-visit and Post-visit activities will reinforce the ideas presented in the exhibition and link classroom learning to the Museum experience. Most activities require few materials and can be adjusted to meet the age and needs of your students.

Pre-Visit Activity:
What is trade?

1. Begin a discussion by asking the students to think about something they need and share a few answers. Continue by asking them to think of something they want and share again.
2. Discuss with them the difference between needs and wants. A need is something that is necessary for survival, such as food and shelter, whereas a want is simply something that a person would like to have.
3. People have to make choices about what things they need and what they want. Why? (People's first concern is survival. Money is often a deciding factor as well.)
4. Have them think back in time when the American Indians came in contact with European people.
    a. Did they use money then? (No, they traded)
    b. What is trade? (Trade is the exchange of goods.)
    c. Why do people trade? (To acquire things they do not have or can't get except through trade.)
5. Ask the students if they think the American Indians people needed to trade? Why or why not? Why did they trade? Have a discussion about the American Indians' use of what was available to them to meet their basic needs. They did some trading with other American Indians groups before the Europeans, what did they trade with them and why? (Were the things they traded wants and/or needs?)
6. Ask the students if they do any trading? What items are traded? Do we still trade today?
7. Have students brainstorm and make a list of objects they might like to trade (5 -10 items). Ask them to decide how they are going put a value on items (not money but some other measure such as 1 baseball card = 2 Pokemon cards or 1 Barbie = 3 outfits of clothes for a Barbie.) Note: This will be challenging and is included to help student begin to consider how complicated the trading process was especially when trading is between different cultures.
8. Finally, ask students whether they like the concept of trading or do they prefer using money. Why or Why not?

9. After returning from your visit to the Museum, talk about what students learned about trading that will add to their ideas from the pre-visit discussion.

Post-Visit Discussion and Activities:

1. After returning from your visit to the Museum talk about what students learned about trading that will add to their ideas from the pre-visit discussion and activities. The following activity can follow this discussion or be done at another time.
2. Trade still holds an important political role in modern times as nations often use trade to solidify old relationships or to create new ones. Yet, how easy is it to trade when you cannot understand one another's language or cultural differences?
3. The purpose of this activity is to discover the intricacies of trade by experimenting with different languages in a mock trade. Through this activity students will have a better understanding of how frustrating trade could be for the parties involved especially if you cannot understand one another.

Activity:

1. Split your class into 2 groups representing the Europeans and the American Indians.
2. Send one group into the hallway (or somewhere that they cannot overhear the other group).
3. Have the Europeans decide what they are going to charge, in beaver pelts, for the following items:
    a. A Hudson Bay blanket
    b. A pound of glass beads
    c. A hatchet head
4. Have the American Indians group come up with hand signals to represent the following:
    a. "Can we trade?"
    b. "How much does it cost?"
    c. "I accept that price."
    d. "I will not pay that much."
    e. "Can we negotiate a different price?"
5. If the groups feel it is necessary, they may want to write down the prices and hand signals so as not to forget during the trade.
6. If possible, have the American Indians rearrange the furniture or "landscape" within the classroom and have them decide with the teacher where the trading post will be within the room.
7. Each group must also pick two representatives for their group that will do the trading. These representatives must be brave, good listeners, generous and people that you are comfortable and confident will represent your group in the best possible way.
8. Let the Europeans back in the room and tell them where the trading post is in the room and let them navigate to that spot.
9. To begin the trade, have the Europeans start with the American Indians; remember, the they say no words, but use only hand signals, and ultimately cannot understand the words being said to them.
10. Discuss with the groups what happened in the trade and the difficulties in communicating with each other.

Travel and Trade Guiding Questions:

The following guiding questions for the *People of the Waters* exhibition area "Travel and Trade" will assist in stimulating class discussion about the exhibit. The guiding questions are appropriate for grades: Elementary, Middle, and/or High School.

Trade Map

1. Which object traveled the furthest? How many times might it have been traded before reaching its final destination?
2. Trade routes were well established before European arrival. What kinds of objects were American Indians trading?
3. How did American Indians transport their trade goods?
4. What were the major trade routes in the U.S.?

Trap and Trade game

1. Why was it increasingly difficult to catch furs in the later generations?
2. What kinds of trade goods did Europeans bring over to trade?
3. Who were the three nations that traded with American Indians?
4. How did the fur trade goods impact American Indian life?

Lesson Plan for People of the Waters Exhibit: Living Cultures
Discussion Questions

Lesson Name: **Living Cultures**

Grade: **Elementary, Middle, and/or High School**

These discussion questions and accompanying activities are directed to meet the Wisconsin Education Act 31 statute. The activities recommended are from resources available through WisconsinAct31.org and their partners. Wisconsin Education Act 31 refers to the statutory requirement that all school districts provide instruction in the history, culture, and tribal sovereignty of the twelve American Indian nations and tribes in the state. WisconsinAct31.org is meant to support educators and librarians in identifying and collecting instructional materials to support Act 31.

The exhibits in the Living Cultures section of the *People of the Waters* exhibition explore the persistence of the American Indian people and their culture by observing and understanding what the people and culture are like today. Students will learn about Chief Oshkosh and his heroic efforts for his people, participate in the interactive exhibit called "What's in a Name," and see the contemporary faces and lands of the tribes as they exist today.

These questions and activities will reinforce the ideas presented in the exhibition and link classroom learning to the Museum experience. Most questions and activities require few materials and can be adjusted to meet the age and needs of your students.

- Chief Oshkosh "Leader in Troubled Times" by Wisconsin Media Lab: Wisconsin Biographies
    - http://wimedialab.org/biographies/oshkosh.html
        - Video (online)
        - "Create an Idea Map" Activity (online)
        - "Design a Trading Card" Activity (online)
        - Story Summaries and Guiding Questions (included for discussion)
- Tribal Nations in Wisconsin Presentation
  ~adapted from WisconsinAct31.org lesson plans by Josh Jackson
- WisconsinAct31.org lesson plans for 11 different American Indian nations in Wisconsin by Josh Jackson
    - Menominee Nation
        - -Lessons: 11, 12
    - Ho-Chunk Nation
        - -Lessons: 19, 21

Wisconsin Biographies Story Summaries and Guiding Questions

WISCONSIN BIOGRAPHIES

Chief Oshkosh – Leader in Troubled Times

Summary

During a time when the United States government was pushing many American Indian nations off their lands, Chief Oshkosh worked to negotiate treaties that would allow the Menominee to stay in their homeland. He also promoted his people's traditional forest management practices, known today as sustainable forestry.

Guiding Questions

1. What historic events did Chief Oshkosh take part in during his life?
2. How did Oshkosh become chief of the Menominee?
3. Describe the Menominee's and the United States government's relationship.
4. What societal pressures on the Menominee existed at the time of the treaty signings?
5. What is Chief Oshkosh's legacy?

Tribal Nations in Wisconsin Presentation

Adapted from WisconsinAct31.org lesson plans by Josh Jackson

Depending on the size of the class, break the class up into groups (4-5 is recommended), each group is required to research one of the 11 American Indian Nations in Wisconsin. The groups will have the next 3 weeks to gather information about your Nation and then one week to create your presentation.

- Things that must be included in the presentation:
- Nation
- Language
- Population
- Status
- Information on one of the following themes:
    - Land and land usage, Resources, Religion
- History of the Nation
- Look at the Nation today
- Synthesis, analysis and connection to what you already know.

The presentation can be done in whatever way that you as a group decide on. You can create a PowerPoint with the information and present that; you can create a poster, a video, anything that you want to do as a group. When you have decided on what you want to create, check in with the teacher to make sure this is something that can be done in the time frame.

Introduction to Lesson Plans by Josh Jackson

Thinking back on my own educational path in school, the one thing that seems the most pervasive now is the traditional view of American Indians that I received growing up. I had exceptional teachers but there was something that was always missing when it came to learning about American Indians. Even as a college student, it was not until I began working on this unit that I realized how little I knew. This unit, therefore, was a journey for me to grow but also to create something that represents the larger scope of issues around how to teach about American Indians.

This unit would not have been possible without the help and time of Ryan Comfort from the University of Wisconsin-Madison. As a non-American Indian, I had these preconceived ideas and notions that had to be broken down prior to even making any progress on this unit. There were multiple occasions that I would leave a discussion with Ryan and not know what to say or how to process what had happened to my schema. After years of inaccurate schema reinforcement, I had to break down my thinking for any progress to be made.

The unit that follows is the journey for me. I had to think about American Indians in a way that I had never thought or be taught. When I began this unit, it was completely from the framework of American Indians as a culture and people of the past. I could not get past the way in which I had learned about American Indians and I had no idea how to begin to think about American Indians in a contemporary fashion. As time progressed and work continued, I was able to begin to see how important it is to present the American Indians in a contemporary light.

The following unit is a combination of Language Arts, Social Studies, and Science. It is designed to be an inquiry-based unit around deconstructing the prejudices that are prevalent about American Indians, and also, to create a sense of appreciation for all the different cultures and people in Wisconsin. The history of Wisconsin is not a single strand of history but rather a shared history among all the people and events. Ignoring American Indian's place in this shared history does all of us a disservice.

This unit hopes to highlight our shared history and show that American Indians are still a part of that fabric. By using storytelling as a mode of communication in Language Arts or by looking at the recent history of the Ojibwe and spear fishing rights, the place of the American Indians is today, not yesterday.

Hopefully, this unit is seen as a starting point for teaching about Wisconsin American Indians in the classroom. This is not a catchall for how to teach American Indians in the 4th grade. It was created based on a hypothetical classroom and was an exercise in curricular planning but the rationale was to show that it is possible. As I began to work on this unit, I realized that I had taken on an exercise that was beyond the scope of a single person. The hardest thing to get past was asking for help and getting started. It is easy to plan a unit on a topic that a person is familiar with, but with limited familiarity the process becomes more difficult. It takes diligence and the willingness to step outside of one's comfort zone to create growth both for educator and student.

Standards for Lesson

Wisconsin Model Academic Standards
Geography
A.4.4 "Describe and give examples of ways in which people interact with the physical environment, including use of land, location of communities, methods of construction, and design of shelters."
A.4.5 "Use of atlases, databases, grid systems, charts, graphs, and maps to gather information about the local community, Wisconsin, the United States, and the world."
A.4.7 "Identify connections between the local community and other places in Wisconsin, the United States, and the world."

History
B.4.7 "Identify and describe important events and famous people in Wisconsin and United States history."
B.4.8 "Compare past and present technologies related to energy, transportation, and communications, and describe the effects of technological change, either beneficial or harmful, on people and the environment."
B.4.9 "Describe examples of cooperation and interdependence among individuals, groups, and nations."
B.4.10 "Explain the history, culture, tribal sovereignty, and current status of the American Indian tribes and bands in Wisconsin."

Political Science
C.4.1 "Identify and explain the individual's responsibilities to family, peers, and the community, including the need for civility and respect for diversity."
C.4.4 "Explain the basic purpose of government in American society, recognizing the three levels of government."
C.4.6 "Locate, organize, and use relevant information to understand an issue in the classroom or school, while taking into account the viewpoints and interests of different groups and individuals."

Economics
D.4.6 "Identify the economic roles of various institutions, including households, businesses, and government."

Behavioral Science
E.4.11 "Give examples and explain how language, stories, folk tales, music, and artistic creations are expressions of culture and how they convey knowledge of other peoples and cultures."
E.4.13 "Investigate and explain similarities and differences in ways that cultures meet human needs."
E.4.14 "Describe how differences in cultures may lead to understanding or misunderstanding among people."
E.4.15 "Describe instances of cooperation and interdependence among individuals, groups, and nations, such as helping others in famines and disasters."

MMSD
Geography
#3 "Explain how physical environment affects the way people live."
#5 "Describe the importance of the movement of people, ideas, and goods, to, from and within Wisconsin."

History
#1 "Examine primary and secondary sources of Wisconsin's history."
#2 "Construct and interpret a timeline of significant people (groups and individuals) and events in Wisconsin's history."
#4 "Describe and explain the history, culture, and contributions of the American Indian tribes and bands in Wisconsin."

Political Science
#1 "Identify the major Wisconsin and U.S. treaties and how they affected Wisconsin tribes."

Economics
#4 "List Wisconsin's natural, human, and economic resources."

Behavioral Science
#1 "Compare and contrast individual perspectives and differences"
#2 "Define culture."
#3 "Explain how personal opinions and choices are shaped by one's family and community."
#5 "Describe the arts and literature, traditions, customs, and celebrations of the diverse cultural groups in Wisconsin including Wisconsin Native Americans."

NCSS

- **Culture and Cultural Diversity**
    - This is one of the guiding standards in terms of the way the unit was designed. As largely social studies based unit, the concept of cultural diversity is seen from the beginning by trying to decompose the prejudices and extract the differences that are there. these differences are not frowned upon, but rather looked at critically and appreciated.
- **Time, Continuity, and Change**
    - For this unit, this manifests itself in the form of looking at the changes that American Indians have made based on multiple facets but also, through the lens of a shared history. As time continues, so does the history and legacy of American Indians in Wisconsin and their ever-changing ways.
- **People, Places, and Environments**
    - This can be seen through the looking at the importance that nature plays into the lives of American Indians. Whether it is the Menominee and their sustained-yield forestry or the Ojibwe and their rice, the relationships between the environments and the people are analyzed.
- **Individual Development and Identity**
    - This is the standard that frames the unit based on the ideas of having the students look at different cultures and histories and begin to appreciate and look at the impact that has been made on these cultures. By breaking down stereotypes, looking at the influence of mainstream culture on American Indians, the interactions of European Americans and American Indians, the students are gaining appreciation for the differences in people.
- **Individuals, Groups, and Institutions**
    - Through the use of simulations in this unit, the unit offers the students the means to study the interactions of American Indians with European Americans. By having them act out the interactions, they can begin to internalize the feelings and then report out these feelings. The historical look also offers the ability for students to look at the changes that have occurred, for better or worse, between the two parties.

- **Power, Authority, and Governance**
    - By looking at the clan structure of the different Nations and the sovereignty of American Indian reservations, the students are gaining experience working with different forms of governance that is not consistent with mainstream governance. The experience with this alternative form of governance offers the students a case study to compare the governance form they are most familiar with.
- **Production, Distribution, and Consumption**
    - This standard is met through the activity and lesson around the Menominee and sustained-yield forestry based on the principle of production and use of the resources present. By using a simulation, the lesson takes on a real-world experience and gives them the agency to think about how the Menominee manage their forest.
- **Science, Technology, and Society**
    - By infusing science and language arts, the interaction between society and science is being seen through the lens of telling stories. These stories rely on the students recreating the information that they have learned in the lesson and then adapt the stories to fit what they have seen in the natural world.
- **Global Connections**
    - By looking at something local and breaking down the barriers that exist, the students will now be equipped with the means to make connections to the world based on the lessons within this unit.
- **Civic Ideals and Practices**
    - This unit is built on the foundation of civic discussion and creating culture and routine in the classroom, especially around self-governance as a class. The students are allowed to identify their own rules and laws and then analyze the ways in which American Indians use similar or different government and the meaning of that.

Lesson #: **11**
Grade: **4th**
Subject Area: **Social Studies**
Topic: **Who are the Menominee?**

Essential Questions

- Who are American Indians Today?
- What is prejudice and how does it affect the way that you look at American Indians?
- How can an understanding of American Indians today help us understand our shared history?

Context

This is the first lesson of the section of the unit around the Menominee Nation of Wisconsin. This lesson is meant to begin to talk about the Menominee: who they are, where they originated, and other important factors. The following lessons will discuss the aspects that you will want the students to represent in their presentations and research.

	Procedures/Activities	Materials
Introduction/Investment	On the board represent the following information: • Tribe: Menominee • Geography: Shores of Green Bay and the Menominee River, moved inland by American policies to their current location along the Wolf River • Language Family: Algonquian • Pop: 7,000 • Status: Federally Recognized with a reservation. (Taken from The Menominee by Ourada) **By doing this, we are beginning to model what type of information we are looking for from the students in regards to their presentations.*** This part will also be important to the introduction of the project the students will be doing and also the way in which they are expected to take notes. See the "Guided Note Sheet" on pg. ______ of this. This will be the manner of taking notes and also what information they will collect on all the presentations as well. For introducing the presentation, use the "Presentation Requirements and Rubric" on pg. ____ of this. This outlines the expectations and also the specific areas that the students need to concentrate on.	*Guided Notes sheet *Presentation Requirements and Rubric *Whiteboard, chalkboard, etc.

Content	The major content that is necessary can be found in Ourada's book but the content most important to this lesson is:
	• The Menominee were hunter-gatherers that did farming of wild rice
	• Known for their tree management
	• Prior to being placed on their current reservation, the leaders, such as Chief Oshkosh were able to persuade the US and Wisconsin to not send them away.
	• One of two American Indian nations in Wisconsin to have their own community college.
	• The Menominee were terminated in 1959 no longer allowing them to have the reservation but were reinstated in 1969.
	• Very complex tribe structure
	  o Different clans represented different areas of expertise and duties
	Took the path of non-assimilation and many of the children were forcibly 'assimilated' due to the private schools.
	• This would be a great point to talk about the concept of assimilation
	• To model this, tell one student that they must act like a chicken or receive more homework.
	  o At some point, the student will find that this is very hard. Ask that student why it was hard to do at some point.
	• You would hope to have the students realize that assimilation does not work because American Indians are not Europeans.
	
	The purpose of the content is to make sure that the students have a general idea of who the Menominee were and think about who they are today.
	
	Make sure to highlight how much the Menominee had to fight to keep their land and not be forced to give up a major part of their identity.	

Whole-Class Activity	As you are giving the students the information in one of the few times of lecturing, play "lecture bingo" Pick out some of the key ideas from the information that you will discuss with the class such as Menominee, Oshkosh, trees, reservation and allowing the students to place the words wherever they want. The object is to give them an active means of listening. As for an activity, there won't be one as a large group but rather the activity will be done during the practice time.	*Lecture Bingo sheets

Practice	For this lesson, I really want the students to create maps and see the huge swatches of land that the Menominee lost as a part of the treaties and cessation of land. To give all students access, have a map with the lines already created showing the different areas but it would be up to the students to write what it meant.	*Map of Wisconsin *Projector to show the different periods of land allotment.
Assessment	For the students, have an exit slip and have them write down what they learned today in class. Easy and simple way to see if the topics need to be touched on again. Add exit slips to KWL chart	Exit slips

Lesson #: **12**
Grade: **4th**
Subject Area: **Social Studies**
Topic: **The Creation of the Menominee and the Clan system**

Essential Questions

- Who are American Indians Today?
- What is prejudice and how does it affect the way that you look at American Indians?
- How can an understanding of American Indians today help us understand our shared history?

Context

	Procedures/Activities	Materials
Introduction/Investment	Start the class with telling the students to close their eyes and listen to the story. This will be very similar to the activities that are done in the Language Arts portion of the unit. http://www.uwsp.edu/museum/menomineeclans/origintext.shtm Play this audiotape that describes and have the students listen to the story. Ask them what it makes them feel. Make sure to emphasize the different animals that the speaker talks about because that will be important.	
Content	For the important content, see the "whole group Activity" because the content being taught is contained in that part of the lesson. Some additional things that should be mentioned: • Menominee did not have one sole leader ○ Clans and clan leaders were part of a committee that ran the nation and made decisions • Each of the clans was responsible for one area but the decisions were made a group and even within the clans, decisions were not delegated to one person	

<table>
<tr><td></td><td><li style="list-style-type:circle">Huge emphasis on the community running the clan and there was a shared responsibility for anything and everything.</td><td></td></tr>
<tr><td>Whole-Class Activity</td><td>Break up the class into five different groups. The five groups are:

Bear – The speakers of the Tribe
The leaders of the tribe but only because of a mutual respect
Eagle – The Warriors of the Tribe
Fought the battles but also served as major opponents to war
Wolf – The Harvesters of the Tribe
Hunters and gatherers of the tribe responsible for food other than rice
Crane – The Builders of the Tribe
Responsible for buildings and necessary objects like baskets, canoes, bags, etc.
Moose – The Rice-Gathers of the Tribe
In charge of harvesting, distributing and protection of rice. Very important to the Menominee.

Each of these tribes had one thing that they were the experts of. During this time, let the teams know that they are going to be the experts and that they must cooperate in order to survive.

Ask the students what it's like to not be an expert in everything. Talk about the dependence on each of the groups.</td><td></td></tr>
<tr><td>Practice</td><td>For this part of the lesson, have the students write in their journals what it felt like to have that dependence on the other parts of the tribe.

What can you relate these clan structures to in your lives right now?</td><td></td></tr>
<tr><td>Assessment</td><td>The students' assessment will be a homework assignment. Have the students discuss what they feel when they think of the following things in the context of being part of a clan structure.
Police, firefighter, Doctor and teacher</td><td></td></tr>
</table>

Lesson #: **19**
Grade: **4th**
Subject Area: **Social Studies**
Topic: **Who are the Ho-Chunk?**

Essential Questions

- Who are American Indians Today?
- What is prejudice and how does it affect the way that you look at American Indians?
- How can an understanding of American Indians today help us understand our shared history?

Context

<table>
<tr><th></th><th>Procedures/Activities</th><th>Materials</th></tr>
<tr><td>Introduction/Investment</td><td>On the board, represent the following information:

Tribe/Nation: Ho-Chunk
Geography: Headquarters are in Black River Falls. Many areas around the state with small parcels of land. 6 tribal casinos
Language: Siouan
Population: 6,000+
Status: Federally recognized without a reservation

Have the students look at this and begin to compare it to the two other Nations that have been looked at in the class.</td><td></td></tr>
<tr><td>Content</td><td>The major content to know about the Ho-Chunk:

Known as the Winnebago (People of the stinking water) But in the Algonquian language, this is not considered an insult
Ho-Chunk means “People of the big voice” or “People of the sacred language.”
Only tribe that speaks a non-Algonquian language -> speak Siouan Language
Broken up into 12 different clans
Earth clans such as the Bear Clan
War-time Chiefs
Sky clans such as the Thunderbird Clan
Peace-time Chiefs
Only American Indian Nation without a formal reservation
Lands owned by the Ho-Chunk that they bought and as the tribe buys more and more land.
2,000+ acres in Wisconsin
Their lands in 1825 consisted of most of SW Wisconsin, including Madison
Black Hawks War had a large impact on the land
Due to some Ho-Chunk supporting Black Hawk, US government used this to take away their land
Ho-Chunk lands were rich in the Galena, which is a lead ore.
Very important to the reasons for Ho-Chunk losing
</td><td></td></tr>
</table>

	their lands o Tie this back to the simulation around why the Americans decided to take this land from the Ho-Chunk	
Whole-Class Activity	For this lesson, lecture bingo would be a great way to involve all the students and also engage them into the information that they will be learning. In reality, this lesson, like the two other "starting" lessons are very important to the students getting a sense of the history of the Ho-Chunk Nation. As a major aspect of the lecture bingo, make sure that the students stop and talk about the things that they have. When the first student gets bingo, have them stop and explain two of the three terms that they got. This way, each student is accountable for knowing the information.	
Practice	First, read the quote, "Do you want our country? Yours is much larger than ours. Do you want our wigwams? You live in palaces. My father, what can be your motive?" (Quote from Speaker Little Elk, 1829) For the practice of this lesson, have the think-pair-share in small groups about the quote and what it means. With the talks that have already been done around loss of lands, try to push the students understanding about why someone would take the lands from the Ho-Chunk.	
Assessment	The assessment will be based on the conversations as a group and in the pairs. As for the formal assessment aspect, offer the students the chance to take what they learned and apply it to other tribes. **What are common themes you have noticed?** This would be a good question to ask to have the students apply their understanding.	

Lesson #: **21**
Grade: **4th**
Subject Area: **Social Studies**
Topic: **Ho-Chunk Lands Today?**

Essential Questions

- Who are American Indians Today?
- What is prejudice and how does it affect the way that you look at American Indians?
- How can an understanding of American Indians today help us understand our shared history?

Context

	Procedures/Activities	Materials
Introduction/ Investment	Show a map of the Ho-Chunk lands. Ask the students what they notice when compared to the lands of the Menominee and Ojibwe. Based on their responses, push the students to predict why the Ho-Chunk may have had less land than the other Nations.	

Content	The important information for the map is:
	• 1832- Black Hawk War which pitted the US government against any Nation that had any relations with the Sauk
	  o Gave the US the ability to push the Ho-Chunk out and take their lead-rich land
	  o Pushed the Ho-Chunk to lands in Iowa
	  o Only a few people signed the treaty but were not from the Bear Clan… VERY IMPORTANT
	• 1847 – Cede the land in Iowa for land in the northern parts of Minnesota
	  o Used as a buffer between the Sioux and Chippewa who were enemies
	• 1855 – Again forced to cede their land in Northern Minnesota but receive better land for planting
	  o Less land but better land.
	• 1863 – Cede land in southern Minnesota for land in South Dakota.
	  o Chief Baptiste described as "bad country for Indians."
	  o Not very suitable for the Ho-Chunk with few trees and cold weather
	• 1865 – Ho-Chunk moved from South Dakota to lands in Eastern Nebraska
	  o This is the land that the Winnebago of Nebraska still live on.
	  o The Ho-Chunk in Wisconsin are ancestors of those that never left Wisconsin or those that returned from the land cessions that they made 30+ years.
	• It wasn't until 181 when the US Senate passed a special bill allowing the Ho-Chunk to buy 40-acre homesteads.
	  o The federal government would not grant the Ho-Chunk reservation status.	

Whole-Class Activity	To put the Ho-Chunk in a contemporary framework, begin with the Badger Army Ammunition Factory in Sauk City. • Most contaminated of all ammunition sites in Wisconsin • Costs of $250 million for cleanup • Land it being sold to the Ho-Chunk… After you have talked about this, ask the children what they think. Is this good or bad? Why? After discussing this idea of the land, ask them to think about whose land this actually is? Why are the Ho-Chunk 'buying' the land back from Wisconsin?	
Practice	Have the students write a letter stating their opinion on the issue of buying the land back and what it means to the Ho-Chunk and the personal feelings of the students. This is to tie the social action aspect into the lesson because this offers the students a first-hand experience doing something that has some meaning behind it.	
Assessment	For the assessment, have each student fill out an exit slip of what they know and add it to the list of things that they have learned in the unit so far about American Indians. This way you can see what they students are grasping and also, if there are things that need to be talked about again.	

Living Cultures Guiding Questions:

The following guiding questions for the *People of the Waters* exhibition area "Living Cultures" will assist in stimulating class discussion about the exhibit. The guiding questions are appropriate for grades: Elementary, Middle, and/or High School.

Mural

- How many tribes currently live in Wisconsin?
- Where are their reservations located?
- What does "Sovereignty" mean?
- Native life is not so different from ours. What kinds of activities do you see American Indians doing?

Map

- Who was Chief Oshkosh and why was he important?
- Why is it important to understand where place names come from?
- Imagine only a few people knew English. What would you do to raise awareness of that language?
- What is languages importance to culture?