



Earth Science Educational Resource for Teachers

The Aurora Fossil Museum opens the door to the exciting world of earth science exploration through hands-on paleontology and rare exhibits on prehistoric life. A “Must See” prehistoric attraction in eastern North Carolina, the Museum provides fun and interesting opportunities to learn by doing. Visitors hunt for finders-keepers fossils in mounds of marl-like material brought from nearby Lee Creek Mine, world-famous for its rare fossil deposits. Inside the Museum, visitors enjoy perusing an impressive shark tooth collection, prehistoric whale exhibit, extensive collection of classic fossils from worldwide sources and North Carolina Native American artifacts.

Admission to the Museum is free and school groups are welcome. Please call ahead to arrange a tour for your group.

Additionally, our Outreach Program takes Museum exhibits and staff on the road to trade shows, school events, community events, civic group presentations and teacher conferences. Contact the Museum staff for more information about opportunities to bring our exhibits to your event.

The Aurora Fossil Museum introduces inquiring minds to the fascinating prehistoric life that existed on the Coastal Plains of North Carolina 20 million years ago. Our unique access to one of the world’s great sources of marine fossils – the Lee Creek Mine operated by PCS Phosphate, only a short distance from the Museum – has greatly enhanced our collections. We welcome people of all ages to come visit the Museum and the Prehistoric District of Aurora.

For more information, contact us at:

AURORA FOSSIL MUSEUM
400 Main Street
P. O. Box 352
Aurora, NC 27806-0352

Phone: 252-322-4238
Email: aurfosmus@yahoo.com
Fax: 252-322-2220
Web: www.aurorafossilmuseum.com

Donations to help strengthen our educational and outreach programs, to support Museum expansion and to expand our collections are welcome and very much appreciated!

This Educational Resource is for your use and convenience. Each time you use these materials please inform the Aurora Fossil Museum with the number of classes and students participating. Reporting these numbers help the museum obtain resources to support our operation.

Educational Resource for Teachers

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Planning Your Field Trip to the Aurora Fossil Museum

Admission: Free

Museum Hours: Open Monday - Saturday 9:00 am to 4:30 pm ALL YEAR.
Open Sunday April 15 - September 15 1:00 pm to 4:30 pm
Please call ahead on Holidays.

Museum Gift Shop: Shop for rare fossils, minerals and jewelry along with t-shirts, toys and novelty items.

Arrange group tours: Contact the Museum staff at 252-322-4238 or aurfosmus@yahoo.com.

Field Trip to PCS

Arrangements may be made with the Public Relations Representative at Potash Corporation of Saskatchewan to take field trips to the PCS operations. This will be a PCS driving tour, no one exiting the vehicle during the tour. This trip takes approximately one hour. Please telephone Mr. Curtis Ormond, Sr. at 252-322-8296.

Obtaining Reject Material for Your School

Reject material from the PCS Phosphate mine is dug from many feet below the Earth's surface and contains ancient marine fossils. Please contact Mr. Curtis Ormond, Sr., 252-322-8296. Material may be available from the museum pile. Please call the Aurora Fossil Museum at 252-322-4238

Identifying Your Fossils

The best guide to identifying the fossil which can be found in the reject dirt in the website: **www.elasmo.com**. Look under the Lee Creek section. This website focuses on the sharks and ray fish from the Pungo river Formation of Beaufort County, NC. This is a Miocene Age deposit. There are excellent pictures and links to most of the teeth that will provide additional information for each species. Website is updated to reflect current research by the Smithsonian Institution.

Other Interesting Websites

enchantedlearning.com
megmawl.com
ncfossilclub.org
naturepreserved.com
megaldonteteeth.com
Aurora Fossil Museum: aurorafossilmuseum.com



Identification Sheet

1



Sevengill shark



Sevengill shark



Sevengill shark



Prickly shark



Cookie-cutter shark



Whale shark



Smalltooth sand tiger - extinct



Sand Tiger - extinct



Sand Tiger - extinct



Sand tiger



Sand tiger



Megatoothed Shark



Great White - extinct



Great White - extinct



Great White - extinct



Great White - extinct



Great White



Thresher shark



Mako - extinct



Mako - extinct



Shortfin mako



Longfin mako - extinct



Longfin mako - extinct



Extinct lamnoid shark



Snaggletooth shark - extinct



Snaggletooth shark - extinct



Snaggletooth shark - extinct



Copper shark



Copper shark



Silky shark



Silky shark



Dusky shark



Dusky shark



Bull shark



Bull shark



Unidentified requiem shark



Lemon Shark



Lemon Shark



Tiger-like Shark - extinct



Tiger-like Shark - extinct



Tiger Shark - extinct



Tiger Shark - extinct

Identification Sheet

2



Tiger shark



Smooth Hammerhead



Skate



Stingray



Stingray



Cownose ray



Mobulid ray - extinct



Shark



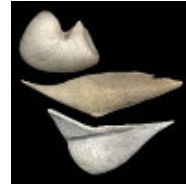
Fish



Fish



Porcupinefish - extinct



Pufferfish



Coprolite



Dolphin



Dolphin



Porpoise



Whale - extinct



Puffin



Crocodile



Crocodile



Turtle



Turtle



Clam shell



Clam shell



Astarte shell



Bittersweet shell



Ark shell



Wentletrap



Turrid shell



Oyster Drill



Drill snail shell



Ephora



Arene shell



Coffee bean



Sand dollar



Sea Urchin



Sea Urchin

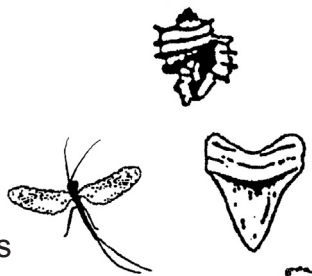
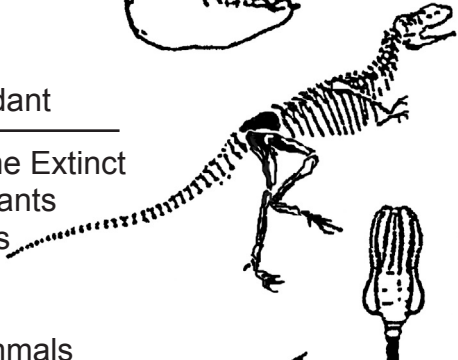
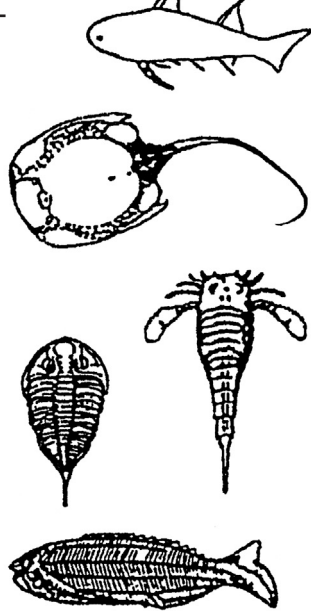



Crab

PCS Mine Stratigraphy

Depth in Feet	Composition	Geological Formation	Geologic Period
+10	Weathered zone sand, silt and clay	Post Croatan	Recent
0	Sea Level		
-10			
-20		—	
-30	Shell bed	Croatan	Pleistocene
-40	Cemented clayey sand	—	2 Million years ago to recent
-50			
-60	Fossiliferous Sandy clay	Yorktown	Pliocene
-70			2-5 Million years ago
-80	Phosphatic clayey sand	Unconformmity	Upper Miocene Age Section missing by erosion 5-15 Million years ago
-90	Shelly dolomite (coquina bed)		
-100	Shelly phosphatic sand		
-110			
-120	Ore Zone	Pungo River	Miocene
-130			15-24 Million years ago
-140	Dolomitic zone		
-150	Phosphatic sandy clay (lean ore)	—	
-160	Hard sandy limestone (aquifer)	Castle Hayne (aquifer)	Eocene
-170			34-55 Million years ago
-180			
-190			
-200			

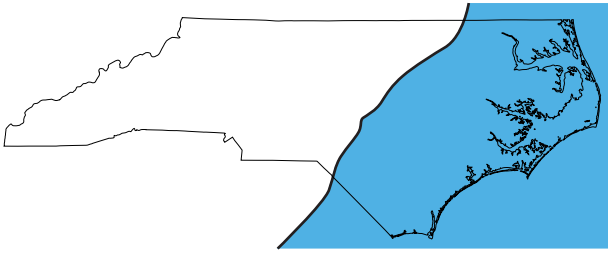
Time Scale

Era	Period	Epoch	Millions of Years Ago	Important Events		
Cenozoic	Quaternary	Holocene	10,000	<p>Modern Man Ice Age Mammoths Mastodons Horses Primitive Elephants True Whales Primitive Hominids Grasses Giant Sharks</p> 		
		Neogene	Pleistocene		2	
	Pliocene		5			
	Tertiary		Miocene		24	
			Paleogene		Oligocene	34
					Eocene	55
	Paleocene	65	Mammals Abundant			
Mesozoic	Cretaceous		144	<p>Dinosaurs Become Extinct Flowering Plants Dinosaurs Conifer Cycads Primitive Mammals</p> 		
	Jurassic		206			
	Triassic		248			
Paleozoic	Permian		290	<p>Mammal Like Reptiles Reptiles Primitive Reptiles Coal Swamps Insects Amphibians Crinoids Shark-Like Fishes Armored Fishes Primitive Land Plants Eurypterids Primitive Fish Corals Trilobites</p> 		
	Carboniferous	Pennsylvanian	325			
		Mississippian	354			
	Devonian		417			
	Silurian		443			
	Ordovician		490			
	Cambrian		543			
	Precambrian				1500	<p>Primitive Marine Animals Green Algae Blue Green Algae Age of the Earth</p> 
		3000				
		4500				

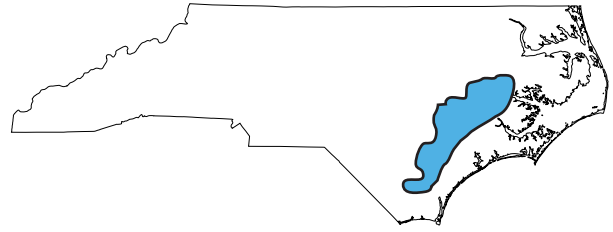
The Geology of the North Carolina Coastal Plain

A review from 65 MYA (million years ago) to the present

Eocene: 55-34 MYA



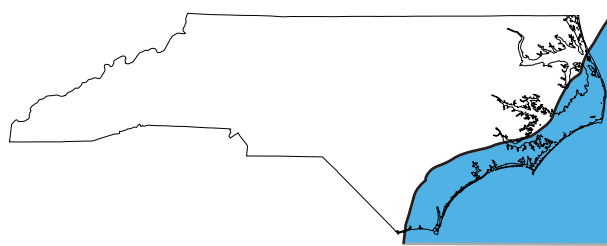
Castle Hayne Deposit



About 65 million years ago the ocean covered the coastal plain to the edge of the Piedmont. During the next 15 millions years the shoreline slowly migrated east.

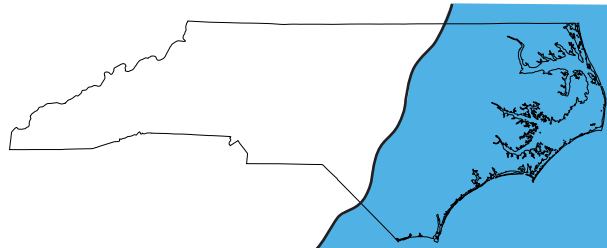
About 50 million years ago the sea reinvaded the land and the deposit known as the Castle Hayne was formed. This limestone deposit contains bivalves, gastropods, corals, fish bones, shark teeth and vertebrae. The shoreline at this time was west of Raleigh.

Oligocene: 34-24 MYA:



The shoreline moved eastward to the Pollocksville area over the next 15 million years. Much of the deposit of the epoch eroded away, but some remains near Maysville and Richards North Carolina

Miocene: 25 - 5 MYA:

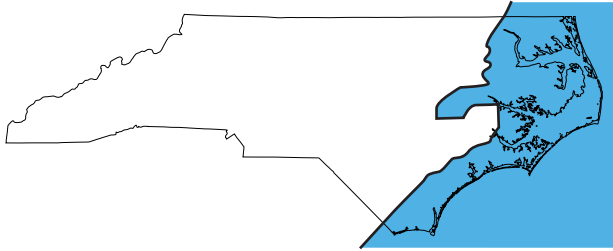


25 - 5 million years ago the sea withdrew all the way to the continental shelf then reinvaded the land and deposited the Pungo River formation. It was probably a closed shallow basin where oxygen was depleted, hydrogen sulfide was formed and phosphate was deposited.

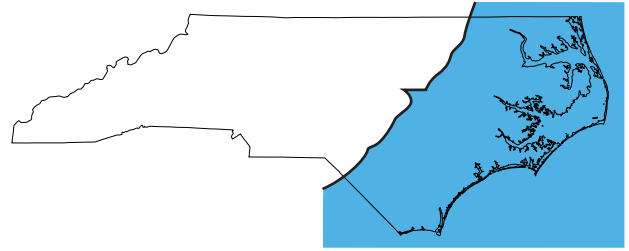
The Geology of the North Carolina Coastal Plain Continued:

A review from 65 MYA (million years ago) to the present

Pliocene: 5 MYA



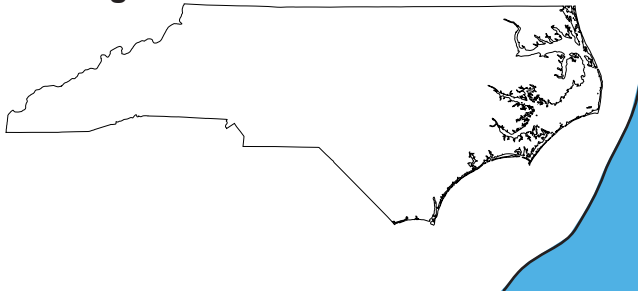
Yorktown Formation: 2-5 MYA



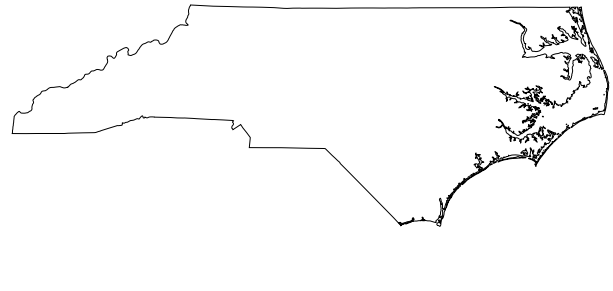
5 million years ago the Yorktown formation began to be deposited above the Castle Hayne formation at New Bern, and the Pungo River formation in Aurora. This was fossil rich material with predominantly shark teeth, marine mammal bones and teeth, fish bones, bivalves and phosphate rocks.

Sea level continued to rise. The shoreline was as far west as the present day Wilson area. Marine deposits were laid down for 3 million years as the sea retreated, and reinvaded the land.

Pleistocene to Recent: 2 MYA to 10,000 Years Ago



Today

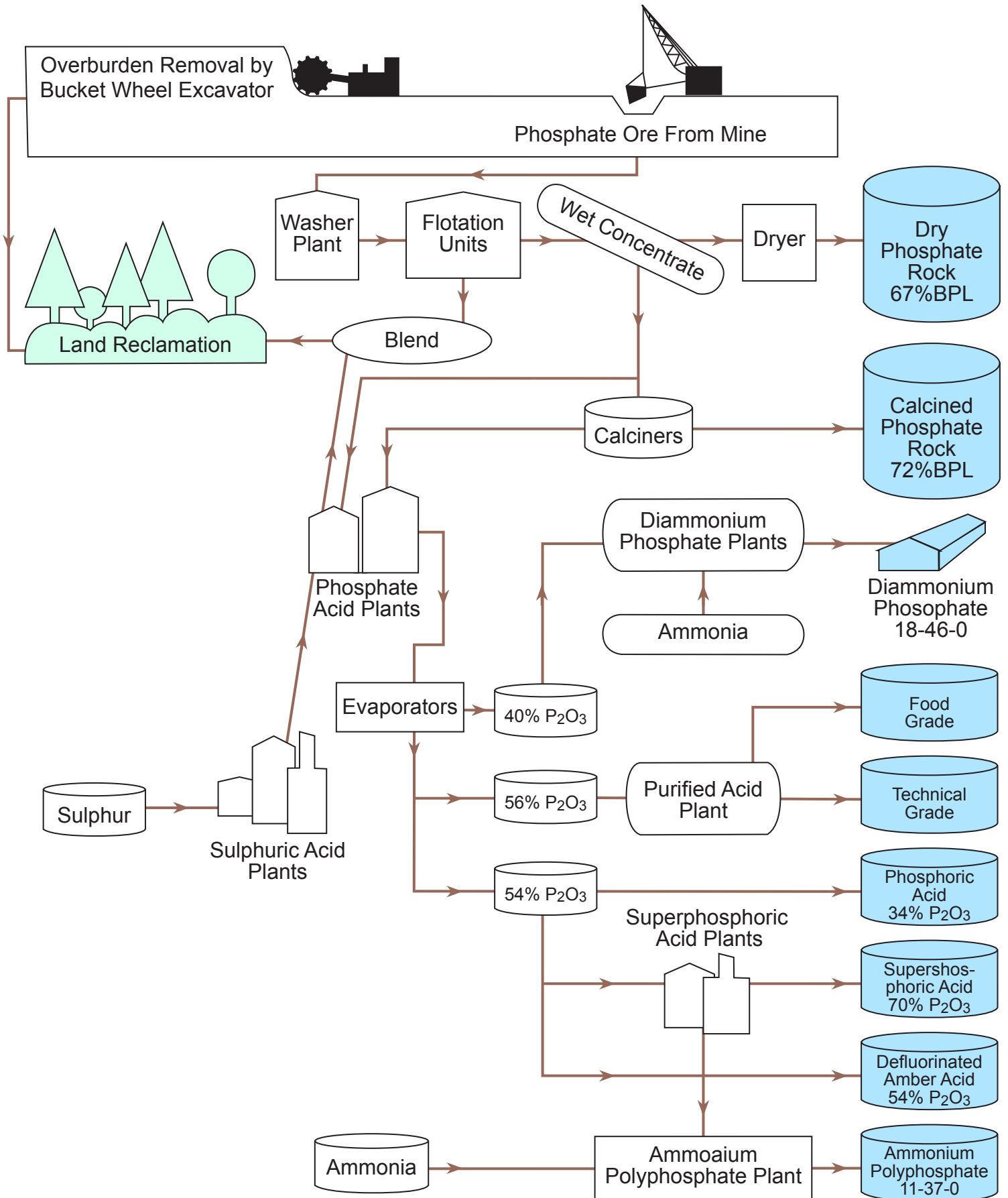


2 million years ago continental glaciation was occurring in the north, no glaciation occurred in North Carolina. The ocean retreated out to the continental shelf as ice grew.

Mammoths and mastodons roamed the coastal plain until they became extinct about 7,000 years ago.

Today the shoreline continues to submerge as sea level continues to rise.

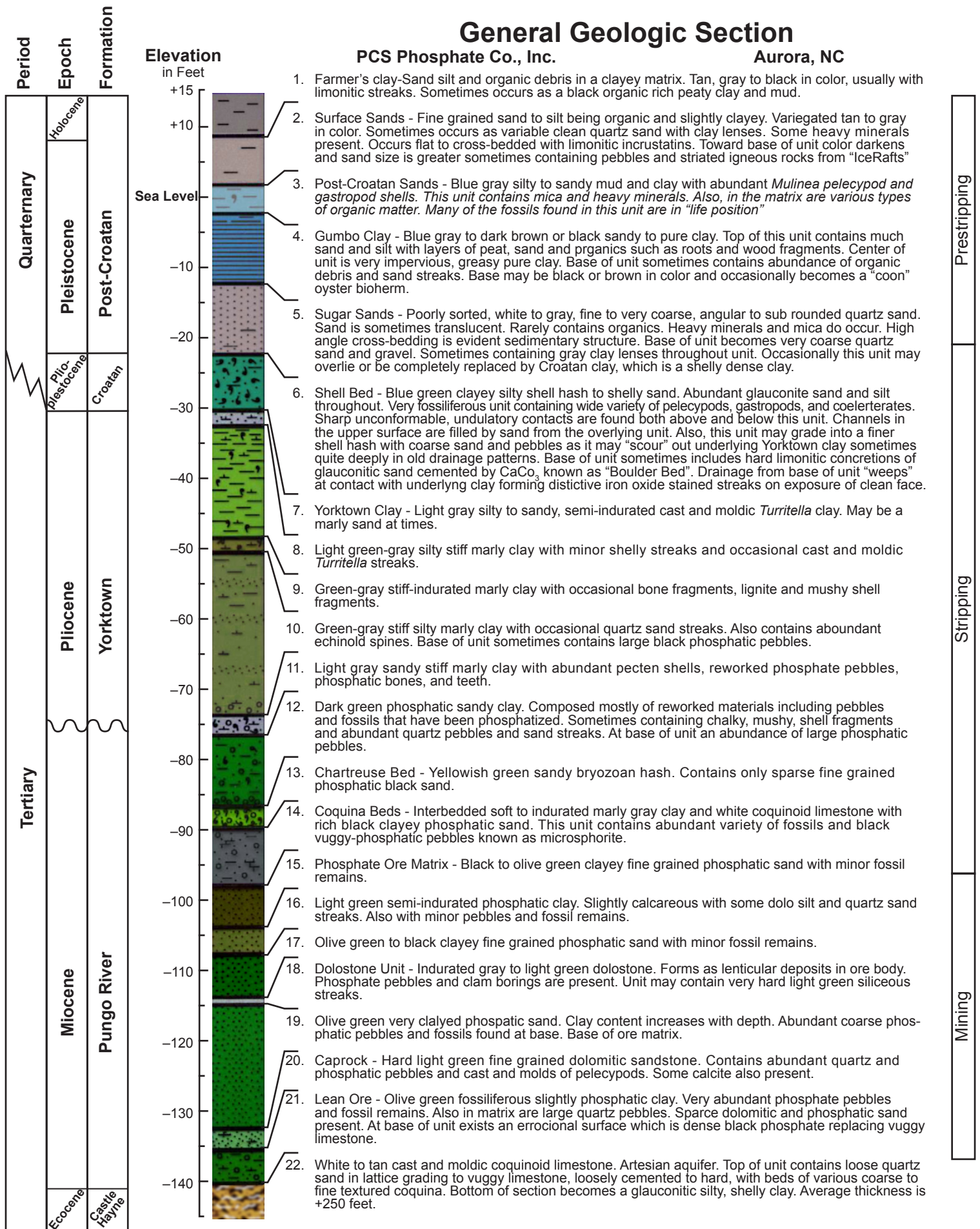
Schematic of the Aurora Mill Flowsheet



General Geologic Section

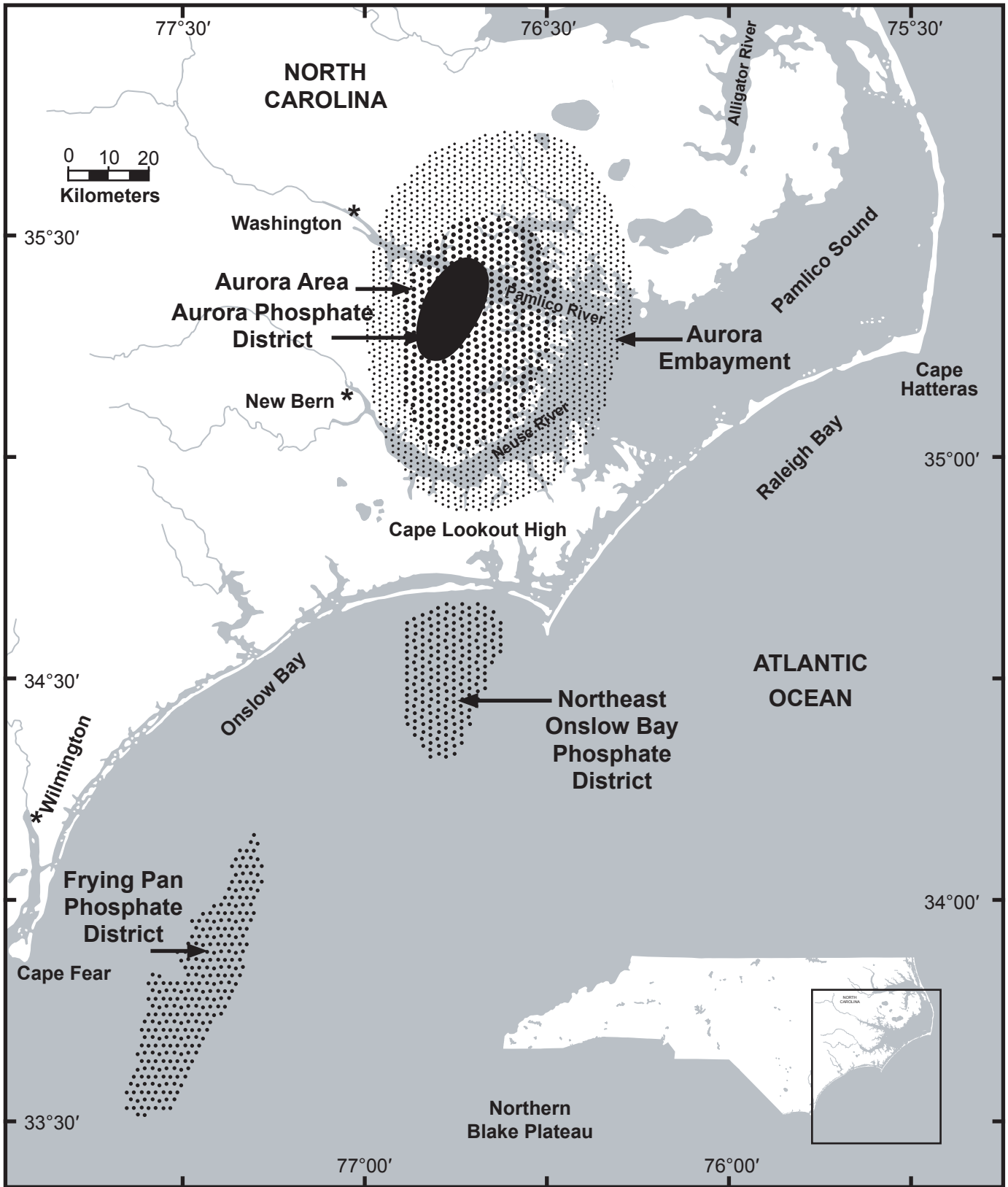
PCS Phosphate Co., Inc.

Aurora, NC



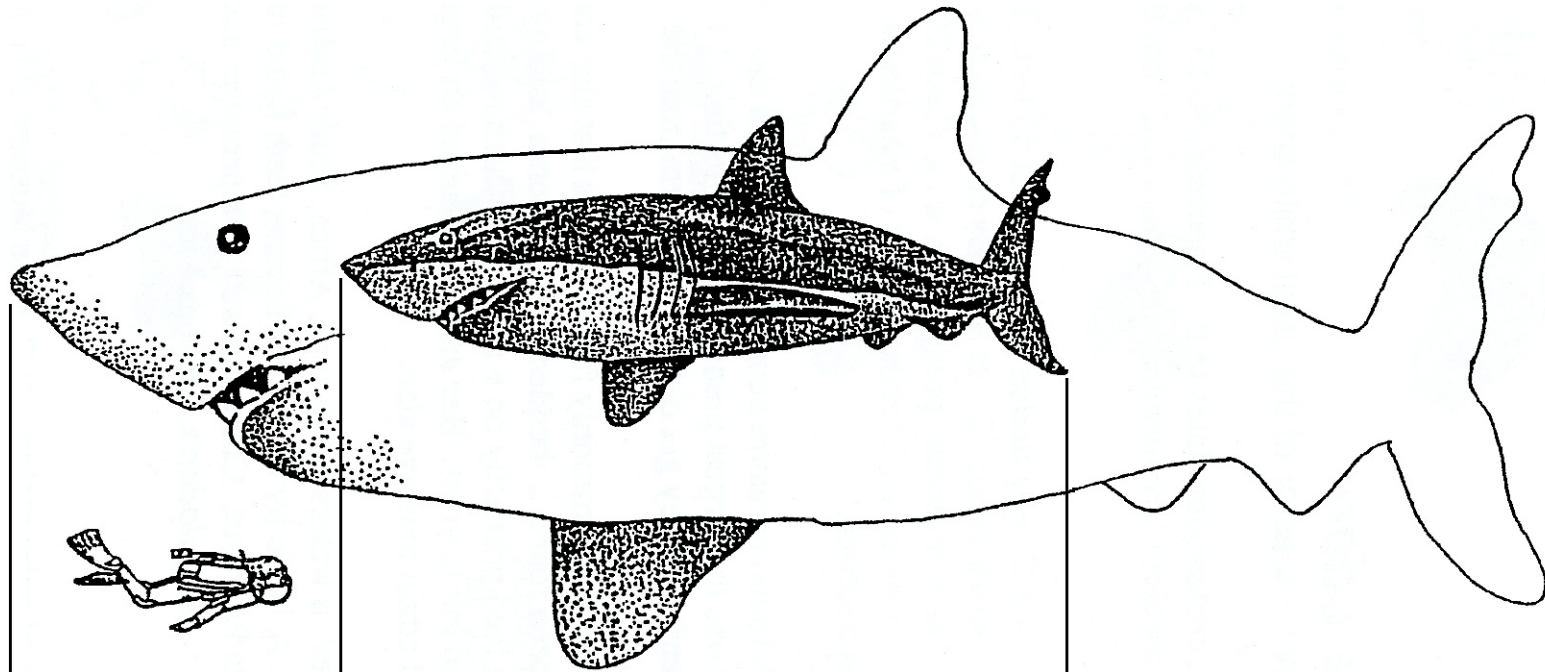
From Mine Block #10 • October 1983, Logged by: I. K. Tex Gilmore C.P.G. • Drawn by SGR 1985 • Revised: 1997, PRM 2003, 2007

Phosphate District Map in North Carolina



Carcharocles megalodon

Ancient Relative of today's Great White Shark



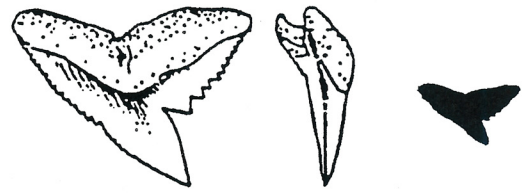
The Great White Shark
grows to about 26 feet

Carcharocles megalodon ancestors appeared 25 million years ago
and grew to more than 70 feet

Ancient Tiger Sharks Teeth



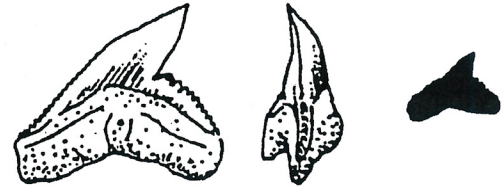
Galeocerdo cuvier
Modern and Ancient



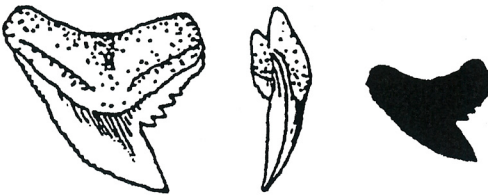
Galeocerdo latidens



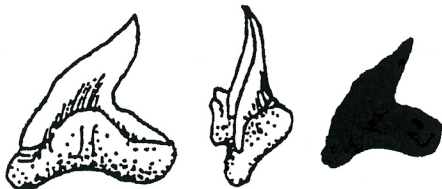
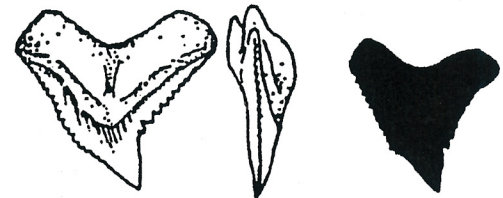
Galeocerdo aduncus



Galeocerdo eaglesomei



Galeocerdo contotrus



Illustrator John Timmerman drew the teeth all the same size to emphasize distinctive features. The actual size of each tooth is indicated by the black silhouette to the right.

Some Facts About Today's Sharks

1. Sharks are members of the fish family. They can have 5, 6, or 7 gills.
2. The largest fish in the ocean is the Whale Shark. It can grow to 50 feet long.
3. The fastest fish in the ocean is the Mako Shark. It has been known to give bursts of speed up to 50 miles per hour.
4. The smallest shark is the Spined Pygmy Shark. It is only 7 inches long.
5. Sharks have no bones in their bodies. Their skeleton is made up of cartilage. Cartilage is the same material as in your nose and ears.
6. Shark babies are born alive. They swim out of their mothers when they are born.
7. There are over 400 different kinds of sharks.
8. Some sharks can live in fresh water. One of these is the Bull Shark.
9. About 26 kinds of sharks can be found in North Carolina waters. Most come here when they are migrating. They may come to have their babies or to find warmer or cooler water.
10. Most sharks eat fish. Some eat crabs and squid. Some clean up the oceans by eating dead animals. Great White Sharks also eat seals. Large sharks will eat smaller ones.
11. The Whale Shark just opens it's huge mouth and lets food float into it.
12. Sharks don't have scales like bony fish. Their bodies are very rough.
13. The sharks liver takes up almost all it's body space. It is used to make Vitamin A.
14. Wide shark teeth are for cutting out chunks of food. The Great White has wide teeth. Narrow shark teeth are for catching food and swallowing it whole. The Mako Shark has narrow teeth. The Tiger Shark has teeth for grabbing and cutting.
15. Sharks can be identified by different colors and patterns on their bodies. The Great White Shark is gray and white. The Mako Shark is blue and white. The Tiger Shark has stripes. The Angel Shark has spots to hide it in the mud. The Whale Shark has large white spots.
16. Scientists are still finding new kinds of sharks.
17. Some sharks are in danger of becoming extinct. The Great White Shark and the Whale Shark are two of them.
18. Some sharks can jump up out of the water. The Mako Shark can jump 20 feet.
19. Stingrays and Skates are members of the shark family.
20. Some people fish for sharks and the meat is good to eat.

North Carolina Shark Teeth Fossils Size and Frequency Checklist

Name	Scientific Name	Size	Frequency	Age					
				Cretaceous	Paleocene	Eocene	Oligocene	Miocene	Pliocene
Requiem	<i>Abdounia cnniskilleni</i>	1/8" - 1/2"	Singular			•			
Requiem	<i>Abdounia lapierrei</i>	1/8" - 1/4"	Very Rare			•			
Requiem	<i>Abdounia recticona</i>	1/4" - 3/8"	Occasional			•			
Thresher	<i>Alopias superciliosus</i>	1/4" - 1/2"	Rare					•	•
Thresher	<i>Alopias vulpinus</i>	1/2" - 3/4"	Very Rare					•	
Ray	<i>Brachyrhizodus wichitaensis</i>	1/2" - 1"	Rare	•					
Requiem	<i>Carcharhinus gibbesi</i>	1/4" - 3/8"	Singular			•			
Requiem	<i>Carcharhinus leucas</i>	1/4" - 1"	Plentiful					•	•
Sand	<i>Carcharias holmdelensis</i>	1/4" - 3/4"	†	•					
Sand Tiger	<i>Carcharias koerti</i>	1" - 2 1/2"	Very Rare			•			
Sand	<i>Carcharias taurus</i>	1/2" - 1 1/2"	Common					•	•
Sand Tiger	<i>Carcharias vincenti</i>	1/2" - 1"	Very Rare			•			
Giant White	<i>Carcharocles angustidens</i>	1" - 4 1/2"	Rare				•		
Giant White	<i>Carcharocles auriculatis</i>	1" - 4 1/2"	Occasional			•			
Giant White	<i>Carcharocles chubutensis</i>	1" - 4 1/2"	Occasional				•	•	
Giant White	<i>Carcharocles megalodon</i>	1" - 6 3/4"	Occasional					•	•
Giant White	<i>Carcharocles carcharias</i>	1/2" - 2 1/2"	Rare					•	•
Lamna	<i>Carcharoides caticus</i>	1/2" - 1"	Singular					•	
Mackerel	<i>Cretodus arcuata</i>	1/2" - 1"	Rare	•					
Mackerel	<i>Cretolamna appendiculata</i>	1/2" - 1"	Rare	•					
Mackerel	<i>Cretolamna biauriculata</i>	1/2" - 1"	Occasional	•					
String Ray	<i>Dasyatis jaekeli</i>	1/8" - 1/4"	Singular			•			
Bramble	<i>Echinorhinus blakei</i>	1/4" - 3/4"	Very Rare					•	•
Tiger	<i>Galeocerdo contortus</i>	1/2" - 1"	Plentiful			•	•	•	•
Tiger	<i>Galeocerdo cuvier</i>	1/2" - 1 1/2"	Common					•	•
Tiger	<i>Galeocerdo eaglesomei</i>	1/2" - 1"	Very Rare			•			
Tiger	<i>Galeocerdo latidens</i>	1/4" - 1/2"	Very Rare			•			
Nurse	<i>Ginglymostoma africanum</i>	1/8" - 1/4"	Singular	•					
Snaggletooth	<i>Hemipristis curvatus</i>	1/2" - 3/4"	Rare			•	•		
Snaggletooth	<i>Hemipristis serra</i>	1/2" - 2"	Common				•	•	•
Bullhead	<i>Heterodontus vincenti</i>	1/4" - 1/2"	Very Rare			•			
Cow - 6 Gill	<i>Hexanchus agassizi</i>	1/2" - 3/4"	Singular			•			
Cow - 6 Gill	<i>Hexanchus gigas</i>	3/4" - 1 3/4"	Very Rare					•	•
Hump-tooth	<i>Hybodus sp</i>	1/2" - 3/4"	Very Rare	•					
Sawfish	<i>Ischyrhiza mura</i>	1" - 3"	Rare	•					
Mako	<i>Isurus hastalis</i>	1/2" - 3 1/2"	Occasional					•	•
Mako	<i>Isurus oxvrinchus (desori)</i>	1/2" - 2 1/2"	Occasional					•	•
Mako	<i>Isurus praecursor</i>	1/2" - 1 1/2"	Occasional			•			
Mako	<i>Isurus retroflexus</i>	1/2" - 1 1/2"	Rare					•	•
Sting Ray	<i>Myliobatis spp.</i>	1/4" - 1 1/2"	Common		•	•	•	•	•
Megamouth	<i>Megachasma sp.</i>	1/2" - 3/4"	Singular						•
Nurse	<i>Nebrius thielensis</i>	1/4" - 1/2"	Very Rare			•			

North Carolina Shark Teeth Fossils Size and Frequency Checklist Continued

Name	Scientific Name	Size	Frequency	Age					
				Cretaceous	Paleocene	Eocene	Oligocene	Miocene	Pliocene
Lemon	<i>Negaprion carybathrodon</i>	1/2" - 3/4"	Rare					•	•
Cow - 7 Gill	<i>Notorhynchus promogenius</i>	1/2" - 1 1/4"	Occasional				•	•	•
Sand Tiger	<i>Odontaspis winkleri</i>	1/2" - 1"	Very Rare			•			
Mackerel	<i>Otodus obliquus</i>	1" - 3"	‡ Very Rare		•				
Pigmy White	<i>Palaeocarcharodon orientalis</i>	1/2" - 1"	‡ Singular		•				
Sand Tiger	<i>Palaeohypotodus rutoci</i>	3/4" - 1 1/2"	Singular			•			
False Mako	<i>Parotodus benedeni</i>	3/4" - 3"	Very Rare					•	•
Sawfish	<i>Pristis fajumensis</i>	1" - 1 1/2"	Occasional				•		
Sawfish	<i>Pristis lathamii</i>	1" - 3 1/2"	Rare			•			
Whale	<i>Rhincodon cf. typus</i>	1/8" - 1/4"	Rare					•	•
Sharptosed	<i>Rhizoprionodon sp.</i>	1/8" - 1/4"	Very Rare					•	•
Sharptosed	<i>Rhizoprionodon sp.</i>	1/8" - 1/4"	Very Rare			•			
Ray	<i>rhombodus binkhorsti</i>	1/4" - 1/2"	Occasional	•					
Ray	<i>rhombodus laevis</i>	1/4" - 1/2"	†	•					
Goblin	<i>Scapanorhynchus texanus</i>	3/4" - 2"	Occasional	•					
Hammerhead	<i>Sphyrna laevissimus</i>	1/4" - 1/2"	Occasional					•	•
Crow	<i>Squalicorax kaupi</i>	1/4" - 3/4"	Occasional	•					
Crow	<i>Squalicorax pristodoncus</i>	1/2" - 1 1/2"	Occasional	•					
Angel	<i>Squatina hassei</i>	1/8" - 1/4"	†	•					
Angel	<i>Squatina occidentalis</i>	1/8" - 1/4"	Very Rare					•	•
Angel	<i>Squatina prima</i>	1/8" - 1/4"	Very Rare			•	•		
Sand Tiger	<i>Striatolamia macrota</i>	1/2" - 2"	Occasional			•			

† Although these have been reliably reported from North Carolina, we have been unable to locate any.

‡ Paleocene age fossils are very rare in North Carolina and almost all examples known have reworked into later formations.

Frequency Key

- Singular: Fewer than 10 ever found
- Very Rare: 6 found per year
- Rare: 15-20 found per year
- Occasional: Can be found with persistence
- Common: You finally quit picking them up

Shark Facts

Name of Shark	Habitat	Size / Age	Diet	Litter	Notes
<i>Megachasma</i> Megamouth	Deep waters	17 ft	Jellyfish, planktonic organisms, copepod		Only 15 known - Nov. 15, 1976 off Oahu, Hawaii
<i>Carcharodon carcharias</i> Great White	Coastal and offshore, Most widely distributed. Swims to 6150 ft dp. cold to tropical	24 ft 4140 lbs	Sharks, fish, seal, sea lion, dolphins, turtles, squid, scavenges whale blubber	5-10 pups 39-59 in,	Good sense of smell. Can maintain body temperature warmer than surroundings. Raises head out of the water. Predators: killer whales and humans
<i>Trianeodon obesus</i> White Reef Shark	Tropical caves Depth 330m	213cm Age 25 years	Fish, lobster, crabs, octopus	1-5 pups 52-60cm 13 mo. gest	Sluggish. Often rest on top of each other
<i>Galeocerdo cuvier</i> Tiger	Warm water Worldwide	24 ft	Everything	shallow	Solitary, commonly found in shallows water
<i>Carcharhinus obscurus</i> Dusky	Temperate and tropical waters. World wide	12 ft			Enters shallow water
<i>Isurus oxyrinchus</i> Mako	Oceanic	12 ft	Tuna		
<i>Hexanchus greisus</i> Cow Shark	Temperate and tropical waters mostly. Found in waters 250-6150 ft deep	Age-80 yr.? Male 11 ft. Female 16 ft. 1300lb	Bony fish, crabs, shrimp, scavenges other sharks and marine mannals	22-108 young 28 inches long	Second most widely distributed shark. Young found inshore. Adults swim to 300 ft deep. Has 6 gill slits
<i>Squatina</i> Angel Shark	Mostly marine in west and east Atlantic to 4260 ft. common in summer	5 ft in east US	Fish, squid, crabs, clams	8-13 pups in 180-300 ft water	Lies buried in the sand or mud during the day. No anal fin
<i>Echinorhinus blakei</i> Bramble aka Hedgehog	1320-3020 ft Atlantic, Pacific, Indian, Marine	11 ft-14 ft	Fish, shark, squid, crab, octopus	15-24	
<i>Carcharinus</i> Leucas Bull	Fresh or salt water Shallow-55 ft	11 ft 16 yr		13 60cm	Considered most dangerous shark. Seldom seen offshore
<i>Negaprion brevirostris</i> Lemon	Coastal waters, bays and inlets. Schools in winter	11 ft 15 yr	Fish, conchs, crabs, seabirds	4 19-18 inches at birth	Dangerous
Sand Tiger	Most commonly found in coastal waters	10.5 ft 300 lbs	Fish in groups	1-2 feed on eggs. 3.5 ft at birth	Sluggish, not known to attack man
<i>Notorhynchus cepedianus</i> Cow (7 Gill)	Temperate to 450 ft deep. South Atlantic, Pacific and Indian Ocean	10 ft	Fish, shark, ray and scavenged food	In shallow bays. 80 pups. 16-18 inches	Green eyes
<i>Hemipristis elongatus</i> Snaggletooth	Pacific Ocean from China to Australia Tropical	Max. 240cm	Shark, ray, squid, fish		
<i>Alopias vulpinus</i> Thresher	Over deep water	18 ft 1000 lbs 15 yr	Schooling fish using tail	3-7 pups 45-61 inches at birth	Have ability to retain heat

Sharks Found in North Carolina and Adjacent Atlantic Ocean Waters

Some 36 species of sharks are known from the estuarine, shelf, and deep ocean waters of North Carolina. With further sampling 10 others, which have been taken in the western Atlantic to the north or south of North Carolina (Delaware to northern Florida), are expected to be included as part of our fauna. The known and expected sharks from North Carolina or adjacent western Atlantic Ocean Waters are listed below.

Common Name	Scientific Name	NC	SC	VA	DE	NJ	nFL	Cari
Six Gill Shark	<i>Hexanchus griseus</i>	X						
Seven Gill Shark	<i>Heptranchias perlo</i>	X	X					
Nurse Shark	<i>Ginglymostoma cirratum</i>	X	X					
Whale Shark	<i>Rhiodon typus</i>	X						
Sand Tiger	<i>Eugomphodus tarus</i>	X	X					
Bigeye Thresher	<i>Alopias superciliosus</i>	X	X					
Thresher Shark	<i>Alopias vulpinus</i>	X	X					
White Shark	<i>Carcharodon carcharias</i>	X	X					
Basking Shark	<i>Cetorhinus maximus</i>	X	X					
Shortfin Mako	<i>Isurus oxyrinchus</i>	X	X					
Longfin Mako	<i>Isurus paucus</i>	X						
Porbeagle	<i>Lamna nasus</i>		X	X		X		
	<i>Apristurus laurussoni</i>				X			
	<i>Apristurus profundorum</i>			X				X
Marbled Cat Shark	<i>Galeus arae</i>		X					
Chain Dogfish	<i>Scyliorhinus retifer</i>	X	X					
	<i>Scyliorhinus meadi</i>	X	X					
Finetooth Shark	<i>Carcharhinus isodon</i>	X	X					
Blacknose Shark	<i>Carcharhinus altimus</i>	X	X					
Bignose Shark	<i>Carcharhinus altimus</i>	X	X				X	
Silky Shark	<i>Carcharhinus falciformis</i>	X	X					
Bull Shark	<i>Carcharhinus leucas</i>	X	X					
Blacktip Shark	<i>Carcharhinus limbatus</i>	X	X					
Oceanic Whitetip Shark	<i>Carcharhinus longimanus</i>	X	X					
Spinner Shark	<i>Carcharhinus brevipinna</i>	X	X					
Sandbar Shark	<i>Carcharhinus plumbeus</i>	X	X					
Dusky Shark	<i>Carcharhinus obscurus</i>	X	X					
Tiger Shark	<i>Galeocerdo cuvieri</i>	X	X					
Night Shark	<i>Carcharhinus signatus</i>	X	X					
Smooth Dogfish	<i>Mustelus canis</i>	X	X					
Florida Smoothhound	<i>Nustelus norrisi</i>						X	
Lemon Shark	<i>Negaprion brevirostris</i>	X	X					
Blue Shark	<i>Prionace glauca</i>	X	X					
Atlantic Sharpnose Shark	<i>Rhizopionodon terraenovae</i>	X	X					
Scalloped Hammerhead	<i>Sphyma lewini</i>	X	X					
Great Hammerhead	<i>Sphyma mokarran</i>	X	X					
Bonnethead	<i>Sphyma tiburo</i>	X	X					
Smooth Hammerhead	<i>Sphyma zygaena</i>	X	X					
Black Dogfish	<i>Centroscyllium fabricii</i>			X				
	<i>Deania profundorum</i>	X						
Bramble Shark	<i>Echinorhinus brucus</i>	X		X				
	<i>Etmopterus bullisi</i>	X						
	<i>Etmopterus gracilispinis</i>			X			X	
	<i>Etmopterus hillianus</i>	X						
Spiny Dogfish	<i>Squalus acanthias</i>	X	X					
Cuban Dogfish	<i>Squalus cubensis</i>	X	X					
Blainville's Dogfish	<i>Squalus mitsukurii</i>	X	X					
Atlantic Angel Shark	<i>Squatina dumerili</i>	X	X					
Gulper	<i>Centrophorus granulosus</i>	?	?					
Greenland Shark	<i>Sommiosus microcephalus</i>	X						

Other Fossil Collecting Localities in North Carolina

Please use contact numbers for more information

Aurora, NC - AURORA FOSSIL MUSEUM - 252-322-4238

Visit the Aurora Fossil Museum and hunt for finders-keepers prehistoric fossils in excavated material from the Lee Creek Mine continually replenished and brought to the Museum's park by PCS Phosphate.

Belgrade, NC - For information contact: Martin-Martin Quarry 910-743-4611

Rocky Point, NC - 910-675-0011

Castle Hayne, NC - 910-675-2283

Martin-Marietta Quarry. Collecting may be allowed on Thursday and Friday from 12pm to 5pm if quarry is not blasting. Call ahead. Children welcome. Hard Hats are required. You will be directed to the collecting area. Liability release must be signed at Main Office. Eocene and Cretaceous age material.

Richlands, NC - Martin Marietta Onslow Quarry - 910-324-7430 - For information contact: 910-324-7430

Goldsboro, NC - Wayne County Neuse River - Need boat to access most of the river. Will dig and screen for Cretaceous fossils

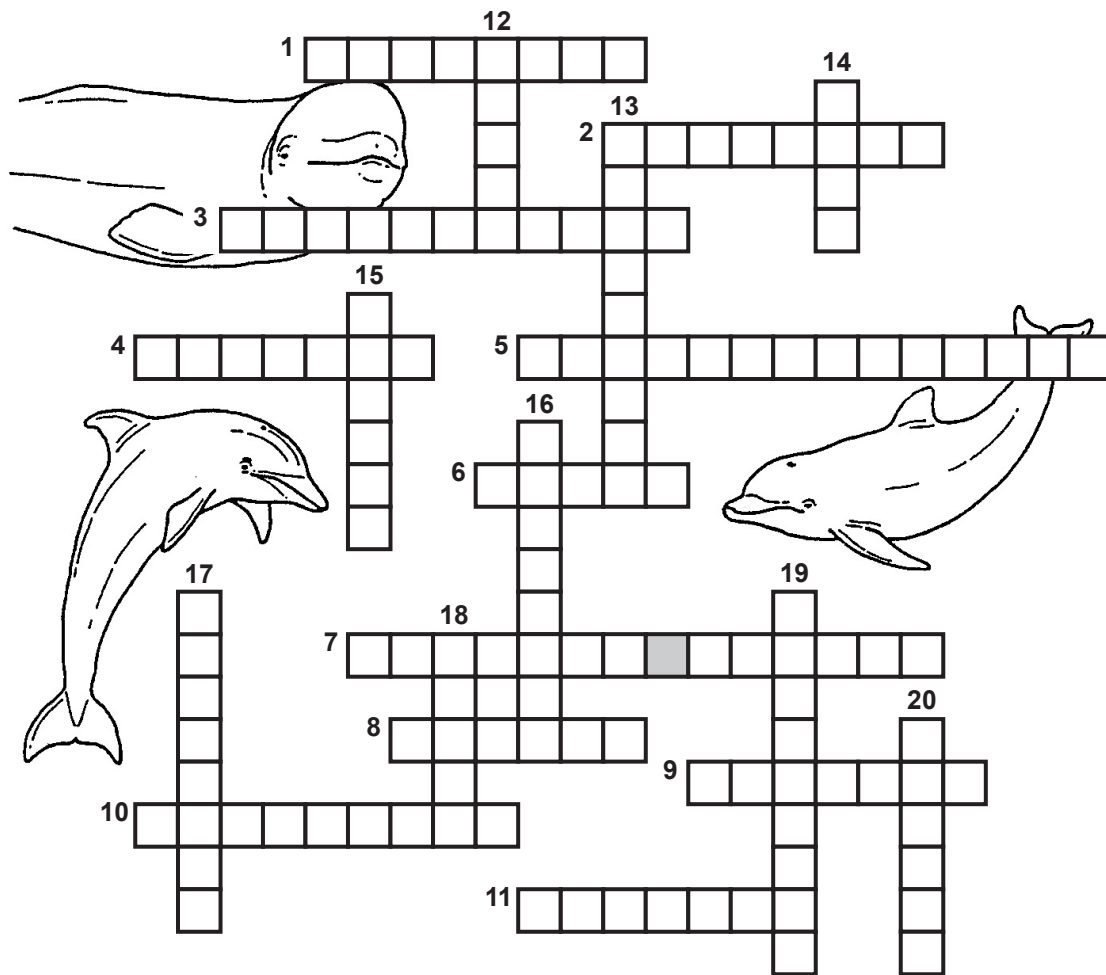
New Bern to Trenton, NC - Trent River - Many fossils of Eocene to Upper Miocene age can be found along the shore. Look for public access areas.

James City, NC - Neuse River - Southward of James City on the Neuse river. Contains many Pleistocene fossils.

Greenville, NC - Green's Mill Run, a small creek running through the heart of Greenville. Must get into the water and shovel and sift. Recommend collecting with a buddy. Easy access behind Elm Street Park. Sharks teeth, belemnites, shells, horse teeth, whale, etc.

Safety is of prime importance when collecting fossils. Parents should keep their children under control at all times. Please carry all your trash with you. Never trespass on private property. Keep the good name of fossil collectors everywhere!

Crossword Puzzle



Choose from these words:

flukes
humpback
echolocation
pods
mammary glands
blubber
narwhal
lungs
plankton
breaching
melon
cetaceans
whiskers
beluga
baleen
blowhole
carnivore
streamlined
krill
flipper

Across:

1. A general term for tiny plants and animals found floating in the sea is _____.
2. Cetaceans have a nostril or _____ on the top of their heads that is used for breathing.
3. Whales have very _____ body shapes to cut down on resistance and allow them to move easily through the water.
4. The _____ is a toothed species of whale in which the male grows one long twisted tusk.
5. Toothed whales can guide themselves with _____ by emitting sound waves into the water which bounce off objects and return to them.
6. Unlike fish which have gills and obtain oxygen from water, whales have _____ and obtain oxygen from air.
7. The _____ are structures found in female mammals that produce milk to feed the young.
8. Whale tails are called _____.
9. The flattened forelimb of a whale is called a _____.
10. Whales and dolphins belong to a group of marine mammals called _____.
11. All whales have a fatty layer of _____.

Down:

12. Baleen whales feed on small shrimp-like animals called _____.
13. A word that describes how whales sometimes leap out of the water and created a big splash is _____.
14. Some cetaceans travel in small family groups called _____.
15. Instead of teeth, some whales feed with sheets of fringed, horny material called _____.
16. A whale famous for its "singing" is the _____ whale.
17. Some whales have hair in the form of _____ growing on their chins.
18. A dolphin has a mass of fatty tissue in its forehead called the _____ through which sounds are projected.
19. An animal that eats meat is called a _____.
20. An Arctic dwelling whale whose white color camouflages it by helping it blend in with the icebergs and ice floes is called the _____ whale.

Shark and Ray Word Search

F R R W E L B M A R B C D E H D A S N A R F F H S
 I M A K O Y I I K B B V A D Q W W U A D L K M W L
 H E J T E E W L R T Y R W T G R R Q A S T J I H I
 L G H U M D G K F H P O E T S S W Y F K L O O A T
 S A W S H A R K J E L L S M E H R T S H A R P L E
 Q L S D F G N G Y S T T A H E E A G L E R A E E Y
 W O Q R R A K T K H R A E T A B Y R E T A M S E E
 F D S H A F K T A E H A M M D R H E K E O A G L G
 T O E Q H A M M E R H E A D W A P Z X N Y Z D I G
 S N F A T O P A D O G W A T Q C A N T O U T D V H
 B V H A R D N O S E V B N T Y U I K O H H G T E J
 D A W U Z H T O O T E L G G A N S C C S A W W D R
 O S S T I N G R A Y S S W Q A E A X V D E B N R S
 G A S K D F W T H K L A D C Z X N Q L L U B N T H
 S D A S I E K A S H W E A G L R D R T Y I S N Y S
 H B B S D N C W A I Q C M I L V T Y U M N I K M I
 A R L C E T G F Y R A B D N A S I R T A A X K Y F
 R A A O D A G L G B A D R E F H G W Z E R G A S R
 K S C P F F K M E G P B C A R P E E E W W I A J A
 A B K P F C O O K I E C U T T E R C E A K L L B T
 B A T E I C B O T K L E M N U V A M R S S L N N I
 S H I R E I B E N V Z X A W R R M E S S O E C M U
 G I P T G T T S N A G G L R P R G M H S S N L C G
 S H A E S I L L I G N E V E S I L K Y D N L W C B
 A K Y S H S D F E N U R T S T V F R H J K Y H O N
 S E Z W E D G E F I S H F R T Y U I P O G S J M C

- | | | | |
|--------------|------------|-----------|--------------|
| BASKING | DOGSHARK | NURSE | SNAGGLETOOTH |
| BIGEYE | DUSKY | PRICKLY | STINGRAY |
| BLACKTIP | EAGLE | SANDBAR | THESHER |
| BRAMBLE | GITARFISH | SANDTIGER | TIGER |
| BULL | HAMMERHEAD | SAWSHARK | TOPE |
| CARPET | HARDNOSE | SEVENGILL | WEASEL |
| CATSHARK | LEMON | SHARPNOSE | WEDGEFISH |
| COOKIECUTTER | MAKO | SILKY | WHALE |
| COPPER | MANTA | SIXGILL | WHITETIP |
| COWNOSE | MEGALODON | SKATE | |
| DEVIL | MILK | SLITEYE | |

Bony Fish Word Search

L I S H R R T A D P C V B A H S I F N R O C I N U
 A D F G A H S I F N O E G R U S T B N Q W R T T A
 N V O B E K A H C V B M E E T C T U N A B B N I N
 T V D C F G S D A A C E P C S O V A R A C B N L M
 E C A C R B A R D C O N G A F G A M A G T U N E N
 R M A C K O M E N O H A D D N B C D U R E R T F S
 N S A N D L A N C E C L A T T O G R F G O O S I F
 F C O F I S A K C V B K X A N B O X F I D B N S N
 I B N Z A E R H E S T A R G A Z E R Z A S X W H W
 S K J B O N S W A R F F E B R W E Q E A S H F G H
 H C A T F I S H B V F R F G H U H A W F C V G G H
 X A X A F C E S D F E W E F I S N J J W F W N M M
 A J C E C R A B H E F G N O P R A T F I S U B N R
 B H L H R J J S L A S F E S D V B N M J F G P B N
 F I S I H B I S T U R E I G R O P G H E S S A R W
 F A N S D F W S B X C W R E A C N M B G T F E H H
 I G G F E W A U V B O X D N S U N F I S H N N M S
 S F D S M U R D E E D N X S X C A T Q U A W I A I
 H J O K L R U I Y T U E E L E R E K C A M V D N F
 Q O R S F R E P U O R G T A S R W Z V B E N R L S
 G A X I C V N N L M O U B O X F I S H U N D A H S
 A W S W O R D F I S H C T X E R T Y B N H E S B A
 R H B O B V F B I G F I A A M A R L I N A R T S L
 T O N G U E F I S H N E N R S T S F X C D I S H T
 H J E T Y A C V Q O D F G R O U Y W E R E F G H U
 A D U C A R R A B K D R A S E A R O B I N G K Z C

BARRACUDA
 BONITO
 BOXFISH
 BURRFISH
 CATFISH
 COD
 CONGEREEL
 CROAKER
 CUTLASSFISH
 DRUM
 FILEFISH

FLOUNDER
 GAR
 GOOSEFISH
 GROUPER
 GRUNT
 HADDOCK
 HAKE
 HERRING
 JACK
 LANTERNFISH
 MACKEREL

MARLIN
 MENHADEN
 POMPAÑO
 PORGIE
 PUFFER
 SANDLANCE
 SARDINE
 SEAROBIN
 SHAD
 STARGAZER
 STURGEON

SUNFISH
 SURGEONFISH
 SWORDFISH
 TANG
 TARPON
 TILEFISH
 TOADFISH
 TONGUEFISH
 TUNA
 UNICORNFISH
 WRASSE

Fossil Word Search

Sharks, Shells, Mammals and Things

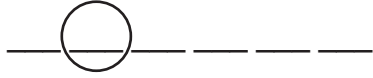
M A B R Y O Z O A N I G H T B T E T
O A Z O X D O Y S T E R I X E R A E
L T L A E L A H W M R E P S A M R F
E S B C R A D I U S B A D X E F O D
M A K O U I H A R B E T R E V S R S
O N J R M N O L Q G R W M U S E U M
N D I A T S M B S E U H E I P T A R
K S V L U X S R B L E I L T K H B B
H E F O N P E M T M U T I G E R A A
Z C W C A V A B I R C E B M A E R L
D P F X I Y U P O R P O I S E S R E
G H A M M E R H E A D W E J I H A N
W O C Y G I C M D R U M Q U N E C E
K R O J S V H R A C S T W A L R U S
M A L T I L I U Q D K A F B A O D H
B S I I L Z N E R A Y P L A T E A G
I S V B K O S U N H L Z P R Q W N O
K R E I Y Y P S E A C O W C L A W U
U L N A W Q I X T P S U R E M U H V
S M A R L I N A C G B I L L F I S H
Y B D A L L E T I R U T M Z N E F S

AMBER
AURORA
BALENE
BARRACUDA
BILLFISH
BRYOZOAN
CLAM
CLAW
CORAL
COW
CRAB
DRUM
DUSKY
ECPHORA
FOSSIL
GREAT WHITE
HAMMERHEAD
HEMIPRISTIS
HUMERUS
LEMON
MAKO
MARLIN
MUREX
MUSEUM
NIGHT
OLIVE
OYSTER
PORPOISE
RADIUS
RAYPLATE
RIB
SAND
SEACOW
SEAL
SEA URCHIN SPINE
SILKKY
SPERM WHALE
THRESHER
TIBIA
TIGER
TUNA
TURITELLA
ULNA
VERTEBRA
WALRUS

Word Scramble

The letters of the following crazy words are all mixed up. To play, put them back into the correct order so that they make real words. All of the words pertain to cetacean characteristics.

1. E N A B A L E



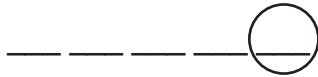
2. P E L I P F R



3. L I R K L



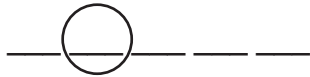
4. O E M L N



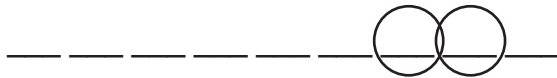
5. T S N A C E E C A



6. K L E F U



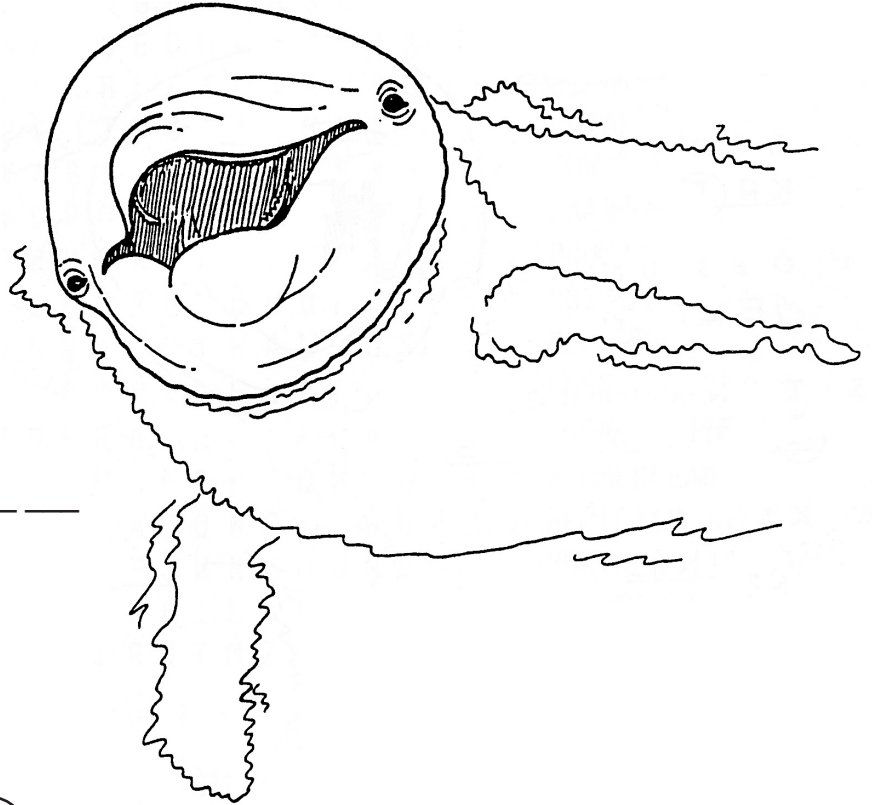
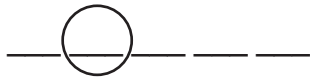
7. N A K L T P N O



8. W L O B E O H L



9. N A O R S



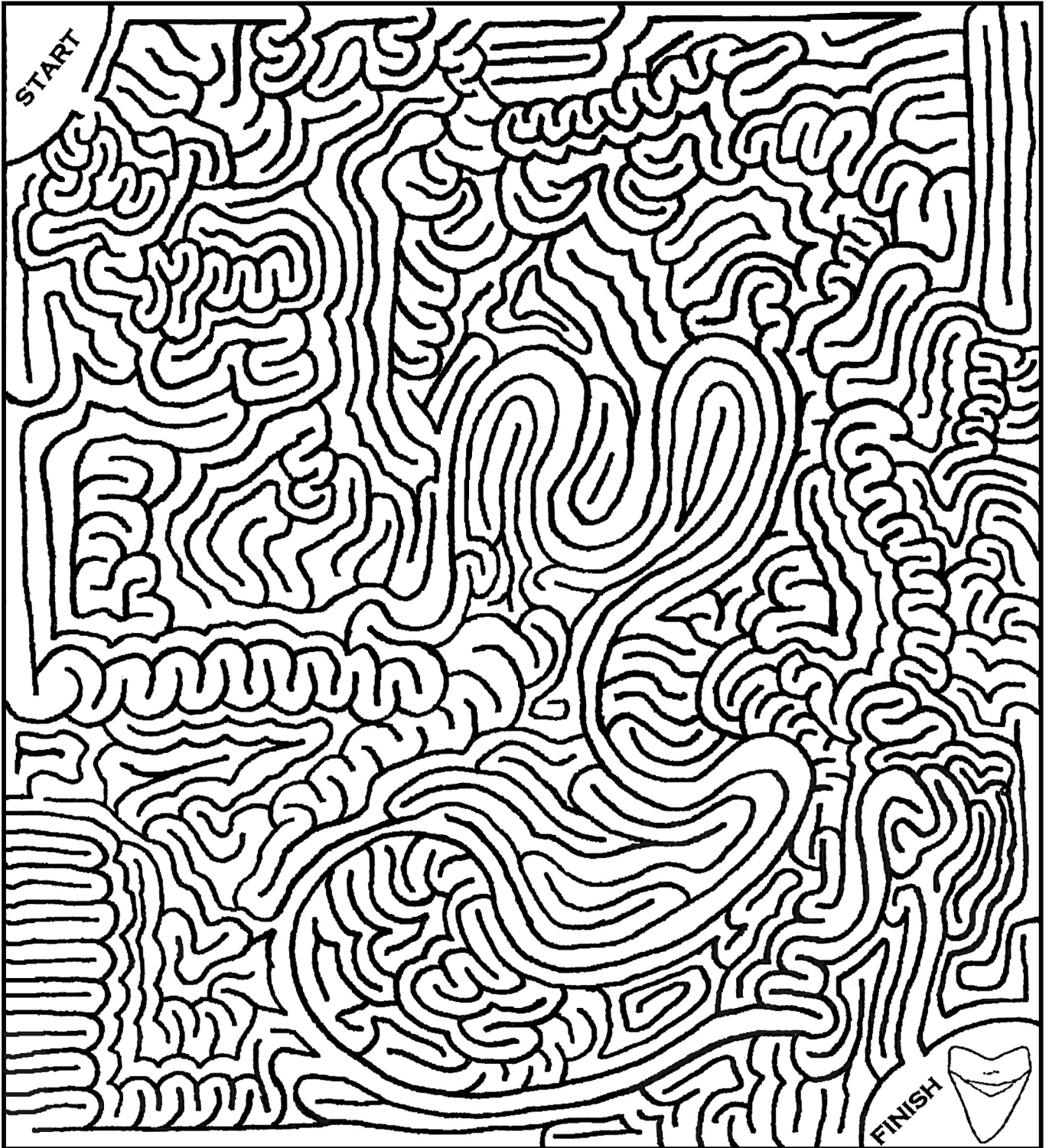
Source; NATIONAL AQUARIUM IN BALTIMORE

Once you have straightened the words out, play around with the letters in the circles. You can put them in order to give you a word that represents a very important concept in cetaceans.

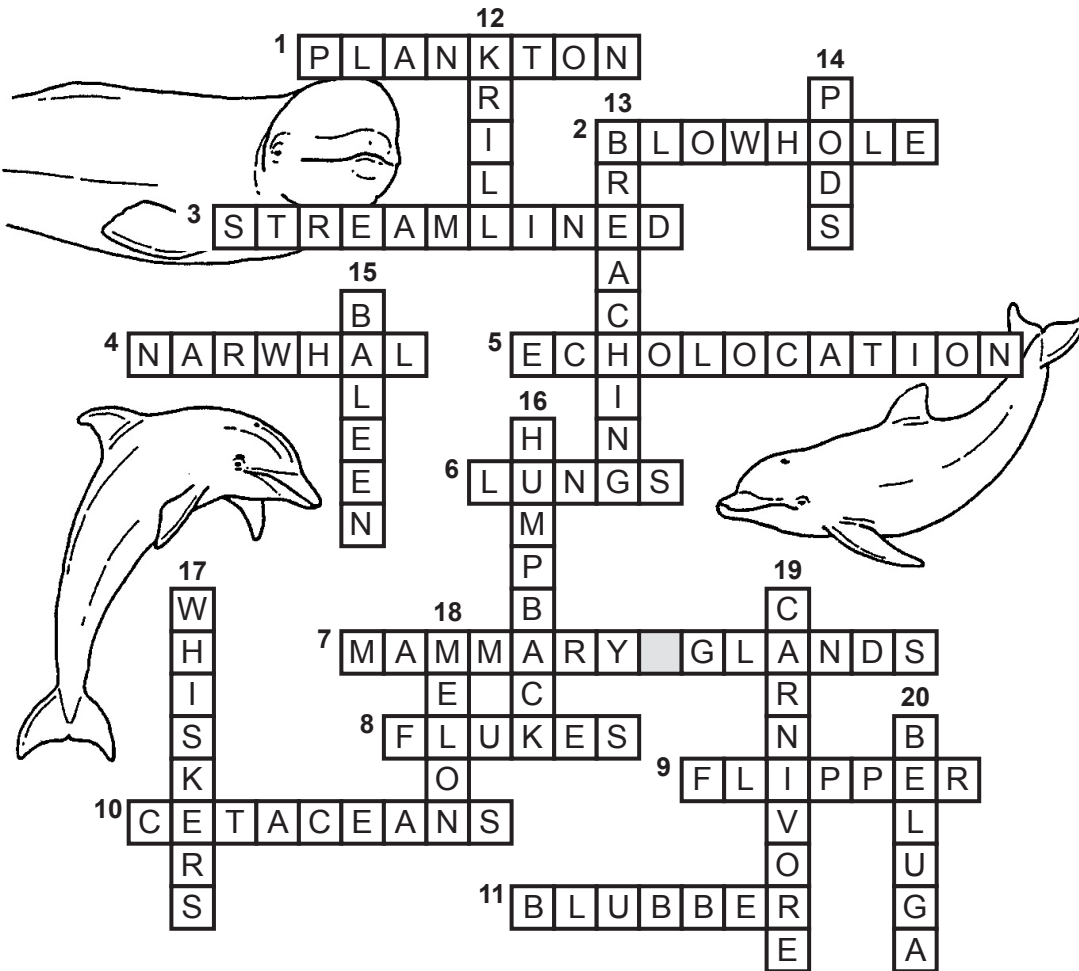
Answer: _____

Maze

Can you find the path to the meg?



Crossword Puzzle ANSWERS



Choose from these words:

- flukes
- humpback
- echolocation
- Pods
- mammary glands
- blubber
- narwhal
- lungs
- plankton
- breaching
- melon
- cetaceans
- whiskers
- beluga
- baleen
- blowhole
- carnivore
- streamlined
- krill
- flipper

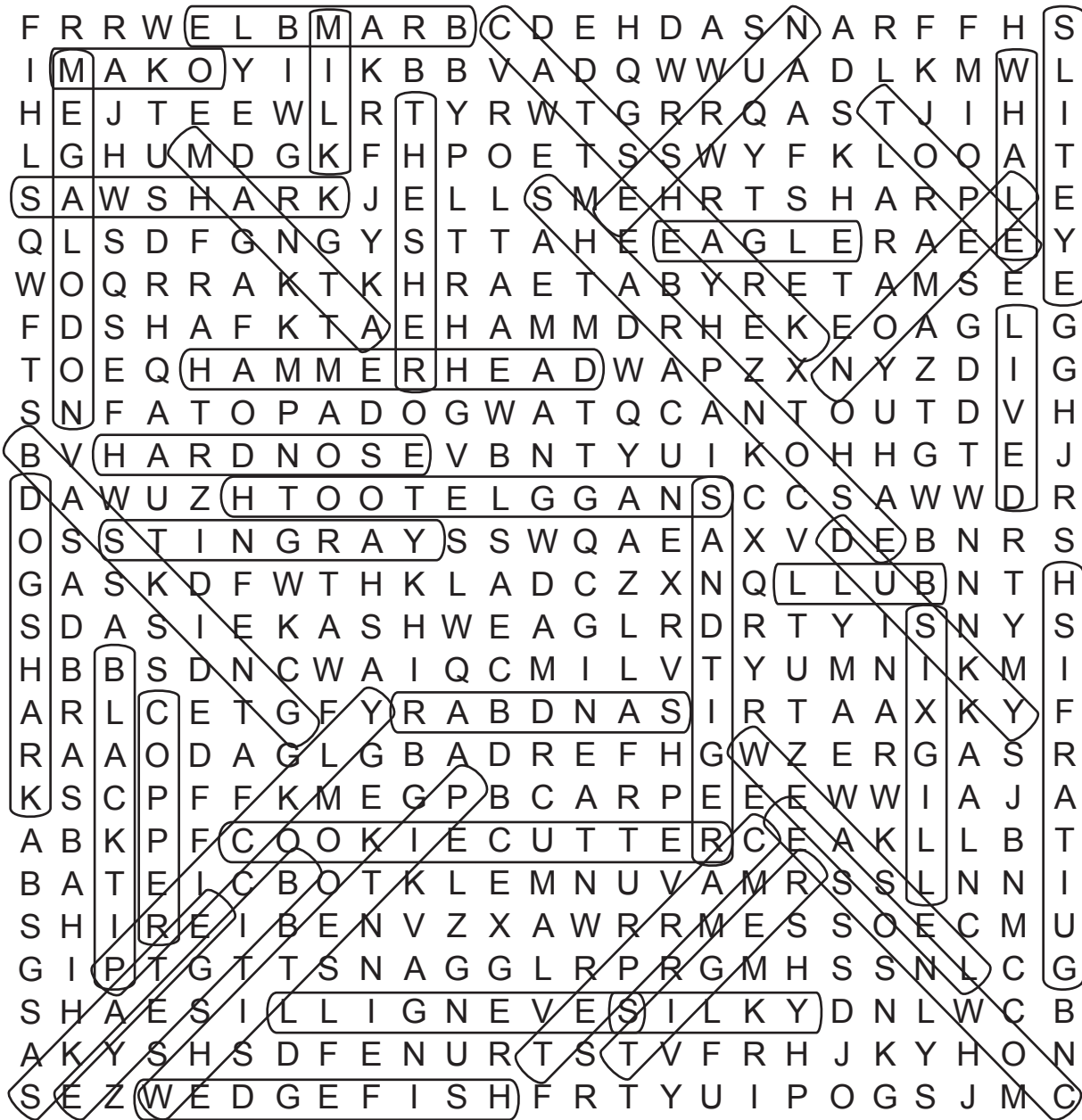
Across:

1. A general term for tiny plants and animals found floating in the sea is _____.
2. Cetaceans have a nostril or _____ on the top of their heads that is used for breathing.
3. Whales have very _____ body shapes to cut down on resistance and allow them to move easily through the water.
4. The _____ is a toothed species of whale in which the male grows one long twisted tusk.
5. Toothed whales can guide themselves with _____ by emitting sound waves into the water which bounce off objects and return to them.
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7. The _____ are structures found in female mammals that produce milk to feed the young.
8. Whale tails are called _____.
9. The flattened forelimb of a whale is called a _____.
10. Whales and dolphins belong to a group of marine mammals called _____.
11. All whales have a fatty layer of _____.

Down:

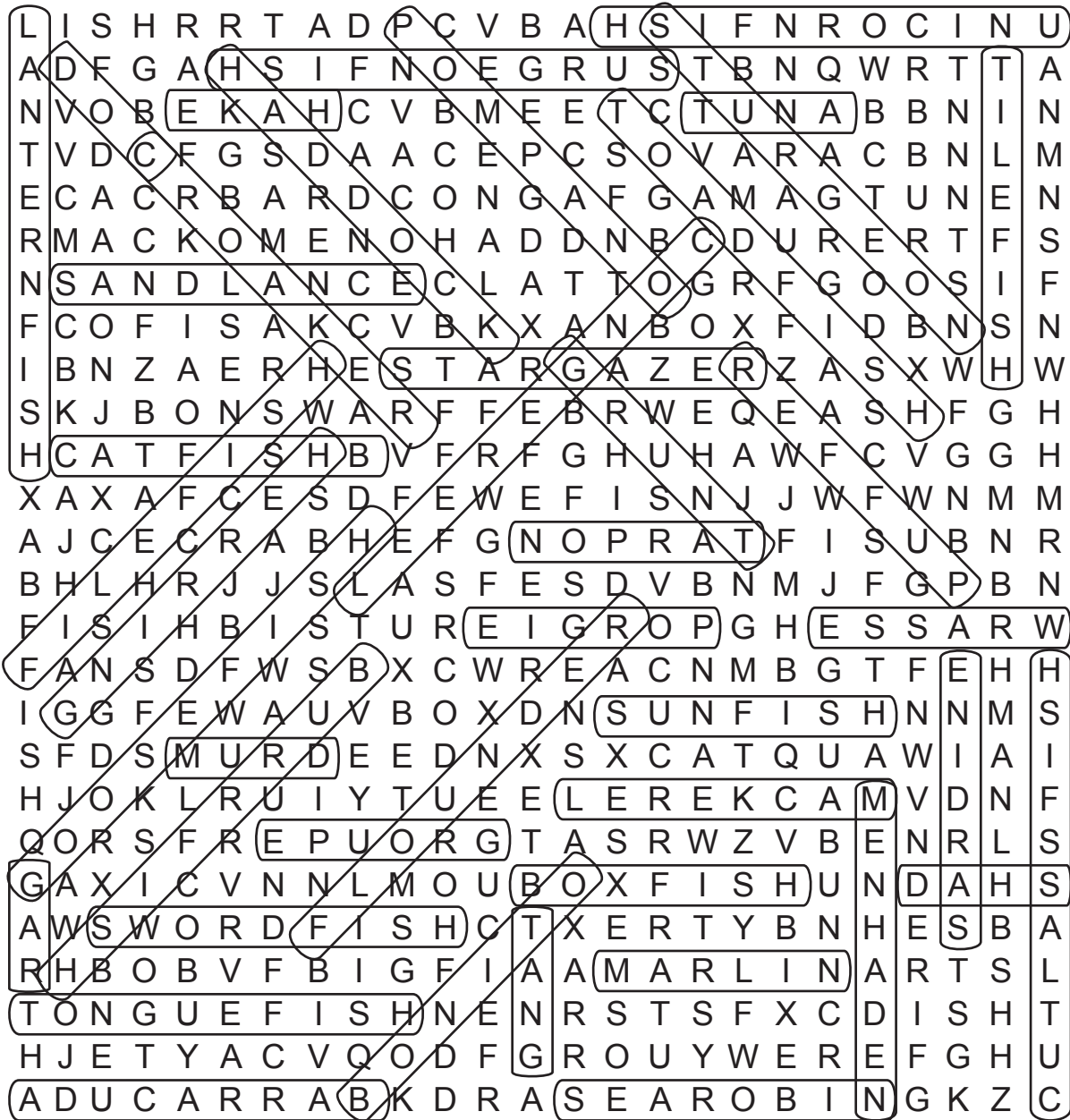
12. Baleen whales feed on small shrimp-like animals called _____.
13. A word that describes how whales sometimes leap out of the water and created a big splash is _____.
14. Some cetaceans travel in small family groups called _____.
15. Instead of teeth, some whales feed with sheets of fringed, horny material called _____.
16. A whale famous for its "singing" is the _____ whale.
17. Some whales have hair in the form of _____ growing on their chins.
18. A dolphin has a mass of fatty tissue in its forehead called the _____ through which sounds are projected.
19. A animal that eats meat is called a _____.
20. An Arctic dwelling whale whose white color camouflages it by helping it blend in with the icebergs and ice floes is called the _____ whale.

Shark and Ray Word Search ANSWERS



- | | | | |
|--------------|------------|-----------|--------------|
| BASKING | DOGSHARK | NURSE | SNAGGLETOOTH |
| BIGEYE | DUSKY | PRICKLY | STINGRAY |
| BLACKTIP | EAGLE | SANDBAR | THESHER |
| BRAMBLE | GUITARFISH | SANDTIGER | TIGER |
| BULL | HAMMERHEAD | SAWSHARK | TOPE |
| CARPET | HARDNOSE | SEVENGILL | WEASEL |
| CATSHARK | LEMON | SHARPNOSE | WEDGEFISH |
| COOKIECUTTER | MAKO | SILKY | WHALE |
| COPPER | MANTA | SIXGILL | WHITETIP |
| COWNOSE | MEGALODON | SKATE | |
| DEVIL | MILK | SLITEYE | |

Bony Fish Word Search ANSWERS



- | | | | |
|-------------|-------------|-----------|-------------|
| BARRACUDA | FLOUNDER | MARLIN | SUNFISH |
| BONITO | GAR | MENHADEN | SURGEONFISH |
| BOXFISH | GOOSEFISH | POMPANO | SWORDFISH |
| BURRFISH | GROUPER | PORGIE | TANG |
| CATFISH | GRUNT | PUFFER | TARPON |
| COD | HADDOCK | SANDLANCE | TILEFISH |
| CONGEREEL | HAKE | SARDINE | TOADFISH |
| CROAKER | HERRING | SEAROBIN | TONGUEFISH |
| CUTLASSFISH | JACK | SHAD | TUNA |
| DRUM | LANTERNFISH | STARGAZER | UNICORNFISH |
| FILEFISH | MACKEREL | STURGEON | WRASSE |

Fossil Word Search ANSWERS

Sharks, Shells, Mammals and Things



- AMBER
- AURORA
- BALEEN
- BARRACUDA
- BILLFISH
- BRYOZOAN
- CLAM
- CLAW
- CORAL
- COW
- CRAB
- DRUM
- DUSKY
- ECPHORA
- FOSSIL
- GREAT WHITE
- HAMMERHEAD
- HEMIPRISTIS
- HUMERUS
- LEMON
- MAKO
- MARLIN
- MUREX
- MUSEUM
- NIGHT
- OLIVE
- OYSTER
- PORPOISE
- RADIUS
- RAYPLATE
- RIB
- SAND
- SEACOW
- SEAL
- SEA URCHIN SPINE
- SILKY
- SPERM WHALE
- THRESHER
- TIBIA
- TIGER
- TUNA
- TURITELLA
- ULNA
- VERTEBRA
- WALRUS

Word Scramble ANSWERS

The letters of the following crazy words are all mixed up. To play, put them back into the correct order so that they make real words. All of the words pertain to cetacean characteristics.

1. E N A B A L E

B A L E E N

2. P E L I P F R

F L I P P E R

3. L I R K L

K R I L L

4. O E M L N

M E L O N

5. T S N A C E E C A

C E T A C E A N S

6. K L E F U

F L U K E

7. N A K L T P N O

P L A N K T O N

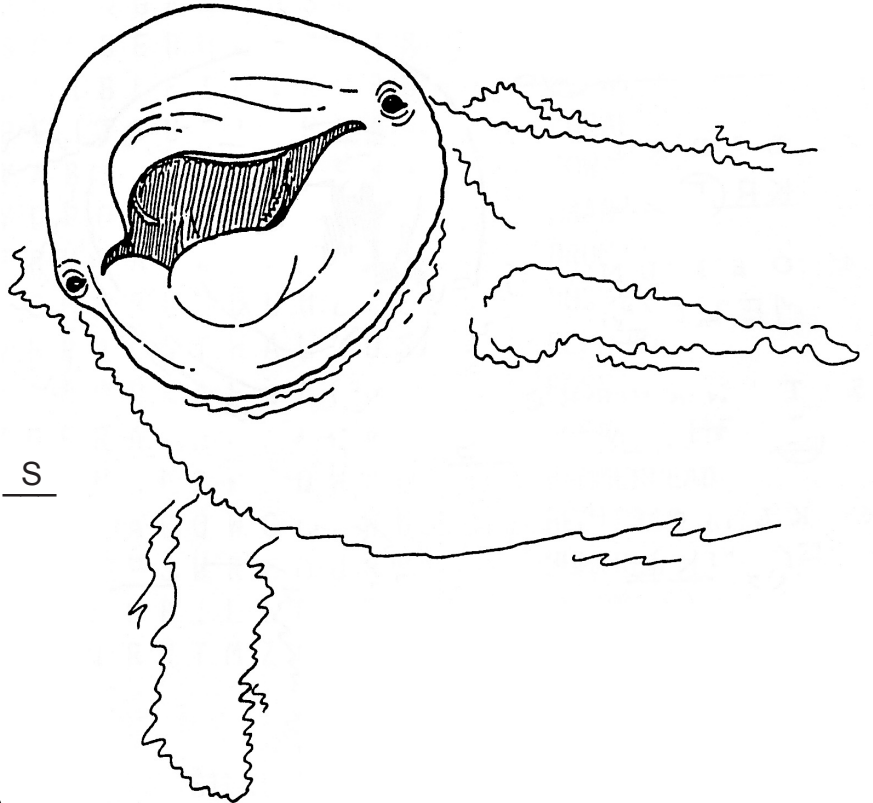
C E T A C E A N S

8. W L O B E O H L

B L O W H O L E

9. N A O R S

S O N A R



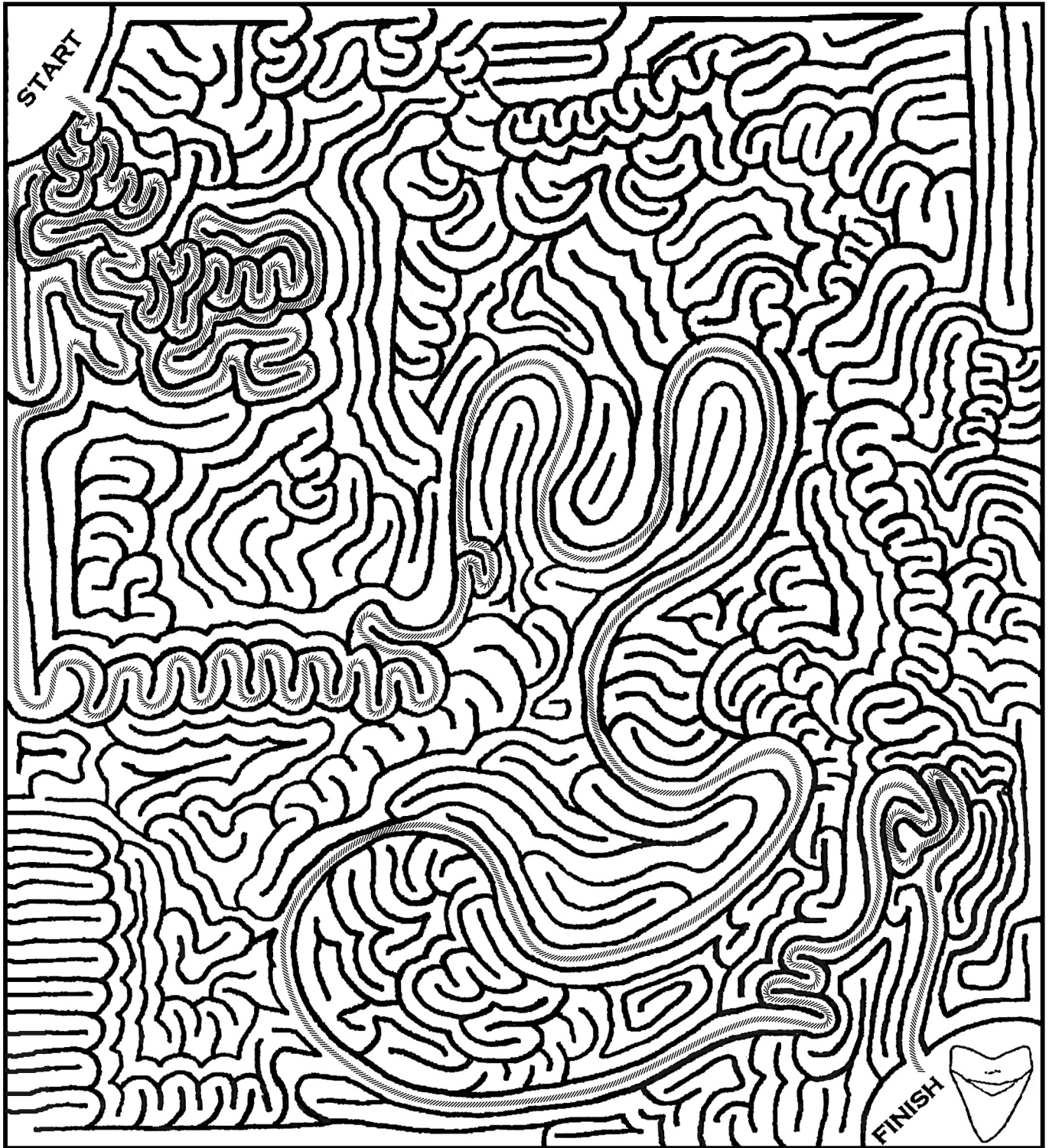
Source; NATIONAL AQUARIUM IN BALTIMORE

Once you have straightened the words out, play around with the letters in the circles. You can put them in order to give you a word that represents a very important concept in cetaceans.

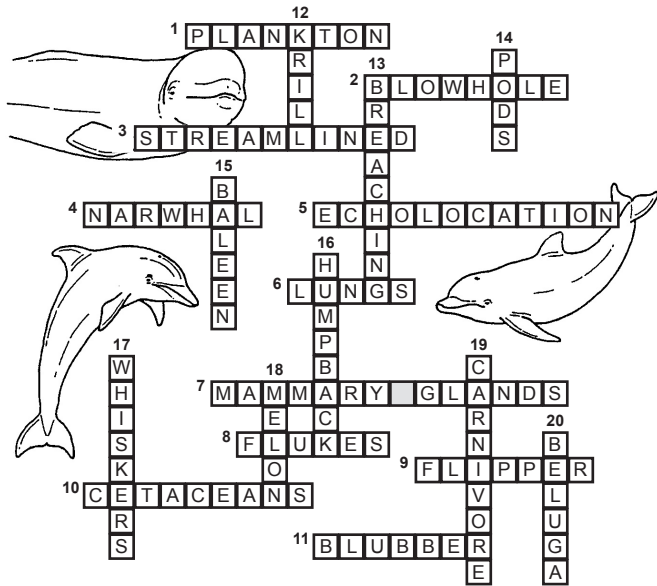
Answer: E C H O L O C A T I O N

Maze ANSWER

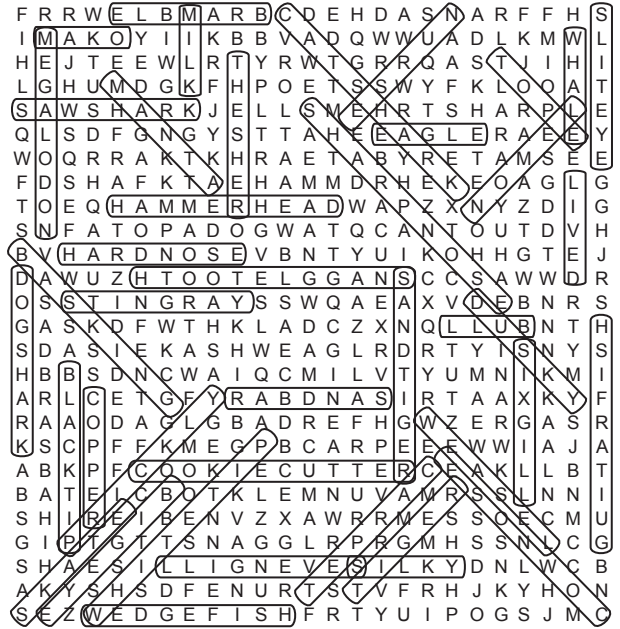
Can you find the path to the meg?



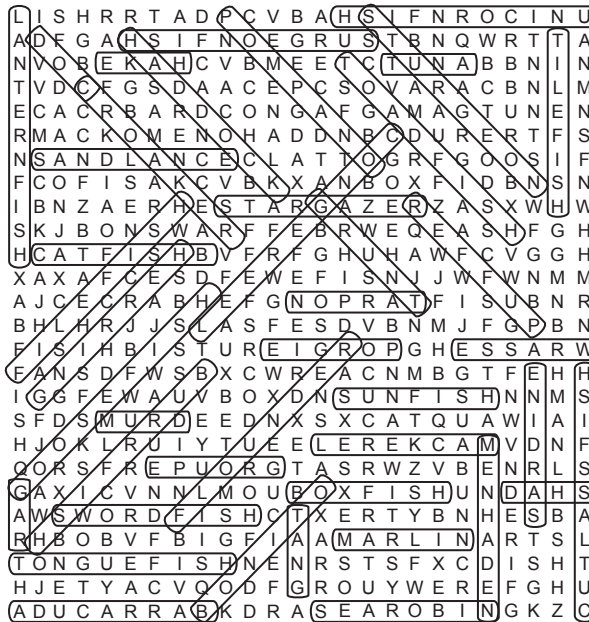
Crossword Puzzle page 21 ANSWER



Shark and Ray Word Search page 22 ANSWER

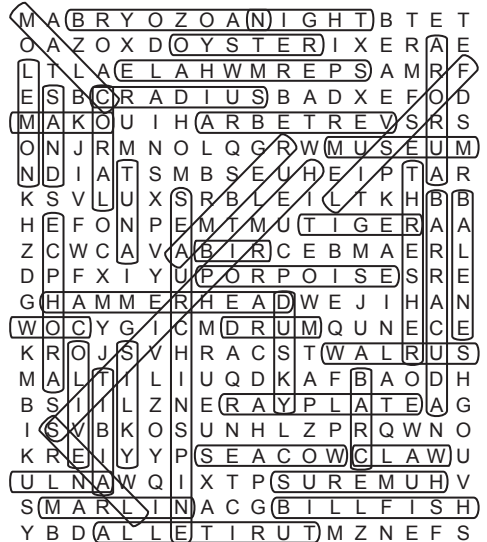


Bony Fish Word Search page 23 ANSWER



Fossil Word Search page 24 ANSWER

Sharks, Shells, Mammals and Things

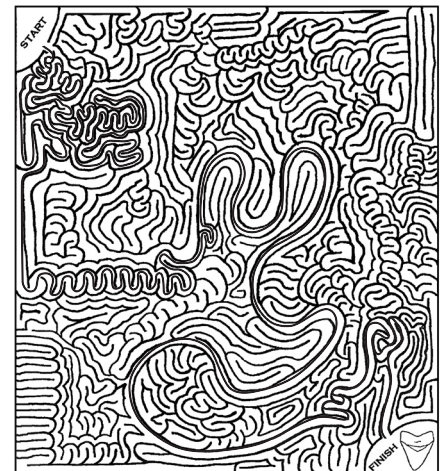


Word Scramble page 25 ANSWER

- ENABALE
B(A) L E E N
- PELIPFR
F L I P P E(R)
- LIRKL
K R I L L
- OEMLN
M E L O(N)
- TSNACEECA
C E T A C E A N S
- KLEFU
F L U K E
- NAKLT PNO
P L A N K T O(N)
- WLOBEOHL
B L O W H O L E
- NAORS
S O N A R

Answer: E C H O L O C A T I O N

Maze page 26 ANSWER



Development of Indian Culture in the Southeast

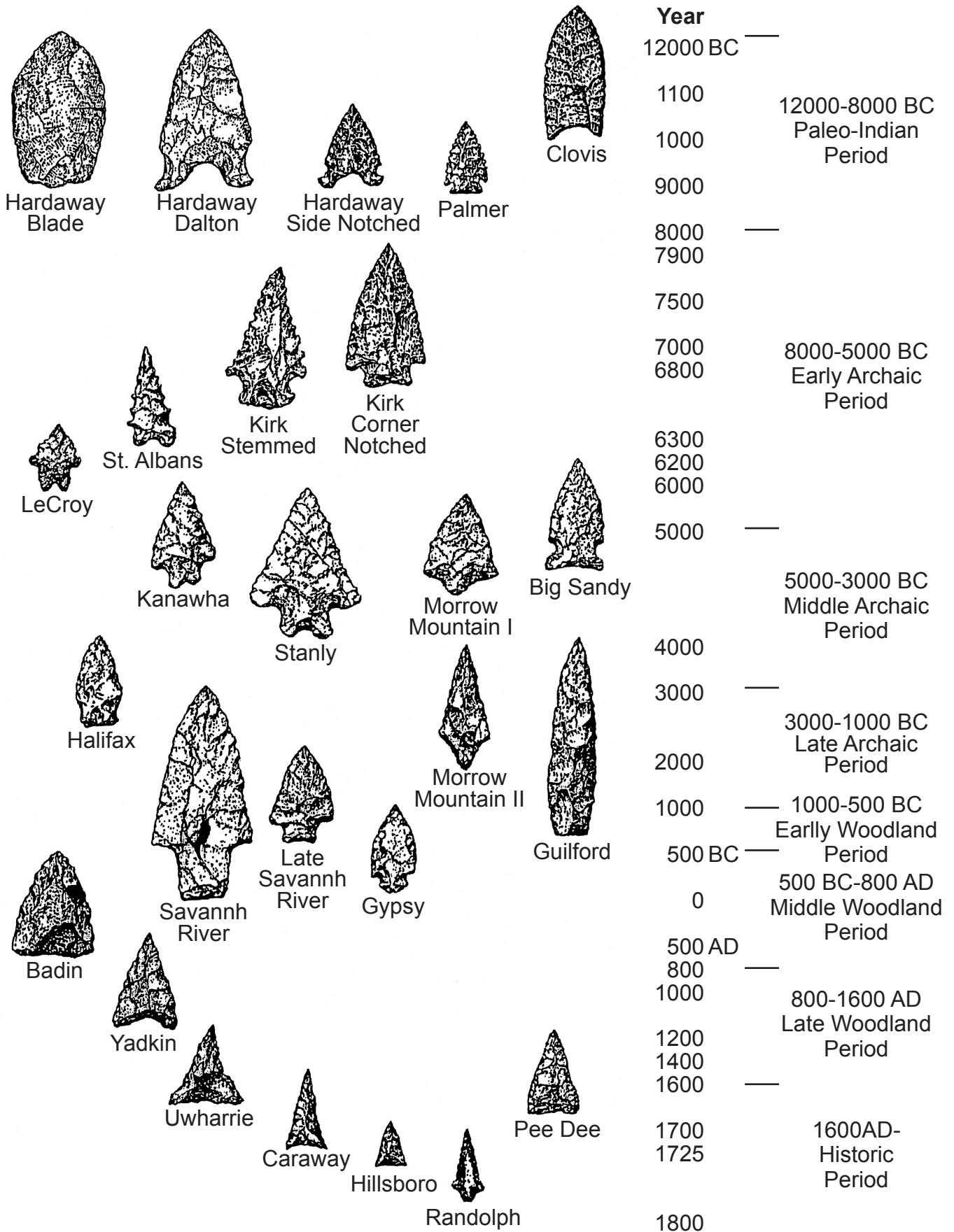
Period	Time Span	Agriculture & Hunting	Social Organization	Cultural Identification
Historic	Present to European Contact Mid 1500's	Agriculture and hunting influenced by European technology.	Relocation experienced by tribes such as Cherokee, Creek, Choctaw, Chichasaw, and Seminole. Extinction of other tribes because of disease.	Introduction and use of the horse. Adaptation of European technology like iron tools and weapons.
Mississippian	European Contact to 900 A.D.	Intensive agriculture supplemented by gathering and hunting.	Construction of large, permanent, fortified towns with ceremonial and public structures. Groups organized as chiefdoms.	Construction of temple mounds, plazas, and earth lodges. Cultivation of beans, corn and squash. Production of effigy pottery and triangular projectile points.
Woodland	900 A.D. to 1,000 B.C.	Gathering and hunting, supplemented by horticulture.	Construction of small, widely spread villages with crops grown on the floodplain. Groups organized as tribes.	First use of bow and arrow. Tempered pottery decorated by incising, stamping, and impressing. Stone and earth burial mounds
Archaic	1,000 B.C. to 8,000 B.C. End of Ice Age	Gathering and hunting, of wild plants and animals. Clearing forest areas to attract game to new growth.	Large, seasonally occupied camps. Groups organized as bands.	Use of ground stone tools: Axe, Grinding and hammer stones. First production of pottery. Use of atlatl, spear throwing weapon.
Paleo-Indian	8,000 B.C. to 10,000 B.C.	Hunting of large game that are extinct today: mastodon, mammoth, giant beaver, ground sloth and musk ox.	Small seasonally occupied camps. 20 to 30 people organized in bands.	Simple tools with lance shaped projectile points: clovis, burins and scrapers

Prehistoric Cultures of the Carolina Indians

	Projectile Points	Weapons	Tools	Ornamentation	Pottery & Vessels	Shelters & Structures	Livelihood
1700 AD	Caraway, Gaston	Flintlock	Iron Axe, Drill, Knife	Glass Trade Beads, Clay Trade Pipe, Button	Plain Pottery, Stamped, Incised	Longhouse	Agriculture, Hunting, Fishing, Food Gathering
1600 AD	PeeDee	Bow & Arrow	Chipped Hoe, Drill, Chipped Celt	Shell Gorget, Shell Bead, Clay Pipe	Stamped Pottery, Basket	Wattle and Clay Thatched Structure	Fishing, Food Gathering
1500 AD	Uwharrie, Clements		Three Quarter Grooved Axe, Drill	Stone Gorget, Clay Pipe	Baskets, Grit & Shell Tamped Pottery with Cord & Fabric Marking, Cord Wrapped Paddle	Huts of Thatch, Bark or Skin	Introduction of Agriculture, Hunting, Fishing, Food Gathering
1000 AD	Yadkin		Muller or Grinder, Celt, Bone Awl	Clay Pipe, Stone Pipe, Stone Platform Pipe			
0	Badin, Vincent						
3000 BC	Savannah River, Halifax	Atlatl or Throwing Stick	Full Grooved Axe, Drill	Engraved Slate	Soapstone Vessels and Baskets	Crude Huts of Bark or Skin	Food Gathering, Hunting, Fishing
4000 BC	Guilford		Chipped Axe, Nutting Stone	Engraved and Perforated Pebbles	Crude Basket	Brush Lean-To	Hunting, Food Gathering
4500 BC	Marrow Mountain I, Marrow Mt II, Stanley		Scraper, Atlatl Weights				
6000 BC	Kirk	Spear	Side Scraper, Graver		Bark or Skin Vessels	Caves or Rock Shelters	Hunting, Food Gathering
6500 BC	Corner Notched, Square Stone, Palmer		Chopper, End Scraper				
8000 BC	Hardaway						
10,000 BC	Eastern Fluted						

N.C. & S.C. Piedmont Archaeological Society

Projectile Point Traditions of the American Southwest



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