Lake Erie Science Field Trip Workbook

STONE LABORATORY

OHIO STATE'S ISLAND CAMPUS ON LAKE ERIE

Sea Grant
Ohio Sea Grant College Program

The Ohio State University

NOAA

CONTENTS

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Visit Stone Lab online at ***stonelab.osu.edu***

WELCOME to Stone Laboratory!

Welcome to Gibraltar Island and Franz Theodore Stone Laboratory, the biological field station for the Ohio Sea Grant College Program and island campus for The Ohio State University.

For more than 100 years, The Ohio State University's Stone Laboratory has been an invaluable asset in freshwater biology research, science education and outreach. Gibraltar Island's location in the western basin of Lake Erie provides an ideal setting for the study of nutrient runoff, shoreline erosion, and population studies of native and exotic species. The island region and the nearby shallow reefs are also a major spawning ground for Lake Erie's fish, providing unique access for students and researchers alike.

Your field trip will put you among the 5,000 or more students in grades 5–adult who will learn at Stone Lab in fall or spring. The lab also offers summer courses for college credits, including both basic and applied field studies in biology, geology, environment and natural resources, and science education.

Since 1990, students from 100 colleges and more than 340 high schools have taken courses for college credit at Stone Laboratory. Someday, you may wish to return for this kind of in-depth experience!

Safety Information: While you are here, we want you to stay safe while you learn and have fun. Because we are on an island, medical facilities are not easily reached in case of an injury.

Please observe the following safety guidelines:

- No running
- Stay away from the edges of steep cliffs
- No throwing rocks
- Be careful of slippery rocks and dock services
- In the event of a medical emergency, immediately contact a chaperone and staff member

The History of Gibraltar Island

15,000 years ago

Ice Age glaciers covered this part of Ohio with ice over a mile thick!

Glacial Grooves formed as glaciers carrying large boulders advanced toward the southwest.

1812

Perry's Lookout: On the northeast shore is a lookout where Oliver Hazard Perry reportedly watched for the British fleet prior to the Battle of Lake Erie.

1852

Half of Gibraltar was granted by Alfred P. Edwards for a monument honoring Commodore Oliver H. Perry's naval victory on Lake Erie, September 10, 1813.

1864

Jay Cooke, Civil War financier, purchased Gibraltar Island for $3,001.

1865

Jay Cooke

Cooke built an elaborate 15-room Victorian home which he called his castle. The Cooke family visited the castle every year until Jay Cooke died in 1905. Perry's Cornerstone was constructed to commemorate the Battle of Lake Erie.

1880s

Laura Cooke Barney built Barney Cottage to use as a residence for guests on the island.

1925

Julius Stone purchased the island and immediately presented the property to The Ohio State University's Board of Trustees for the Lake Laboratory. The laboratory was named after Julius' father, Franz Theodore Stone.

Commodore Perry

The Battle of Lake Erie

Cooke Castle and Perry's Cornerstone

The History of Gibraltar Island

Julius Stone

Laboratory building

Waldock Gazebo

Solar pavilion

1929

Stone Laboratory building opened for research and teaching. Today the building provides classrooms, office space, library, bookstore, and computer room. The Dining Hall was also constructed.

1930

Stone Cottage was constructed for family use by Julius Stone. Today it provides housing for instructors, visitors and guests. Gibraltar House was built for the caretaker and now provides housing for laboratory staff.

1981

FOSL: Friends of Stone Lab began as a support group for Stone Lab.

1985

Harborview Dormitory was constructed as a modern dormitory for students.

1991

A bat house was constructed by FOSL using lumber salvaged from demolition of Jay Cooke's boathouse.

1996

Waldock Gazebo and Lakeview Pavilion were constructed with funds donated by Jack Waldock, past chair of the Northwest Sea Grant Advisory Committee and member of the Director's Advisory Council.

2012

The solar array and Dining Hall solar thermal were installed.

2014

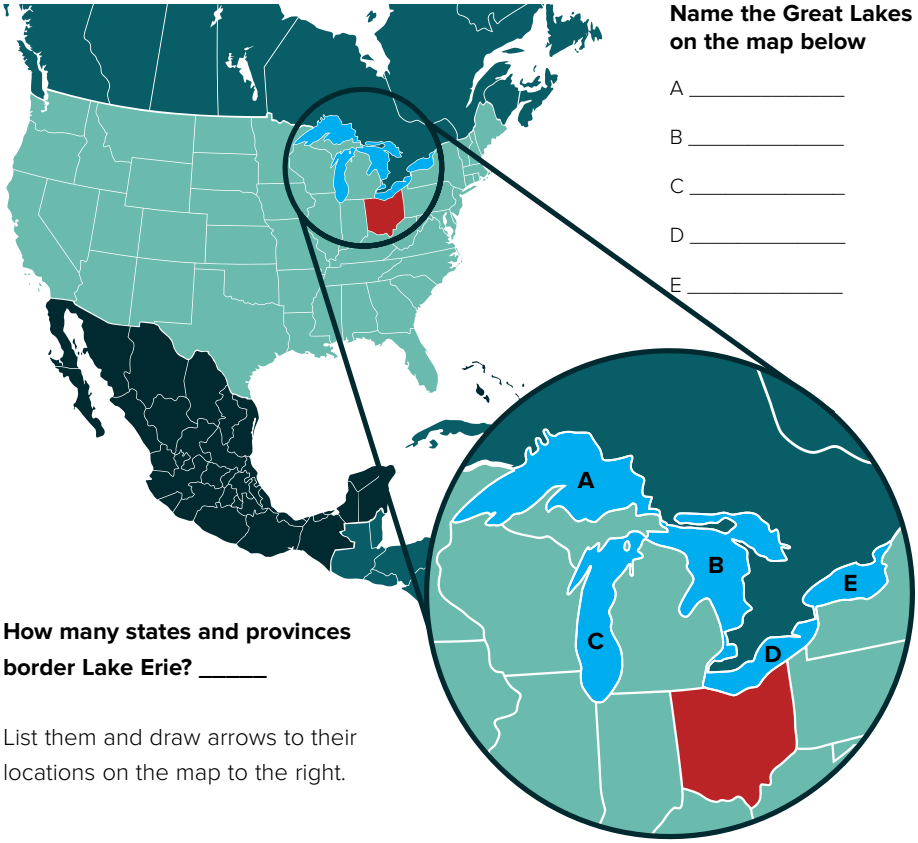
Solar panels mounted on top of the classroom building provide supplemental power to the island.

Where in the World Are We?

Where in the World Are We?

Where in the World Are We?

The Great Lakes: The Great Lakes of North America hold 20% of the surface freshwater on the planet, making them an important natural resource for millions of people. In the United States alone, 90% of our surface freshwater is found here. Ten percent of Americans and 25% of Canadians live in the watershed of the Great Lakes.



Name the Great Lakes on the map below

A _____

B _____

C _____

D _____

E _____

How many states and provinces border Lake Erie? _____

List them and draw arrows to their locations on the map to the right.

_____ _____

_____ _____

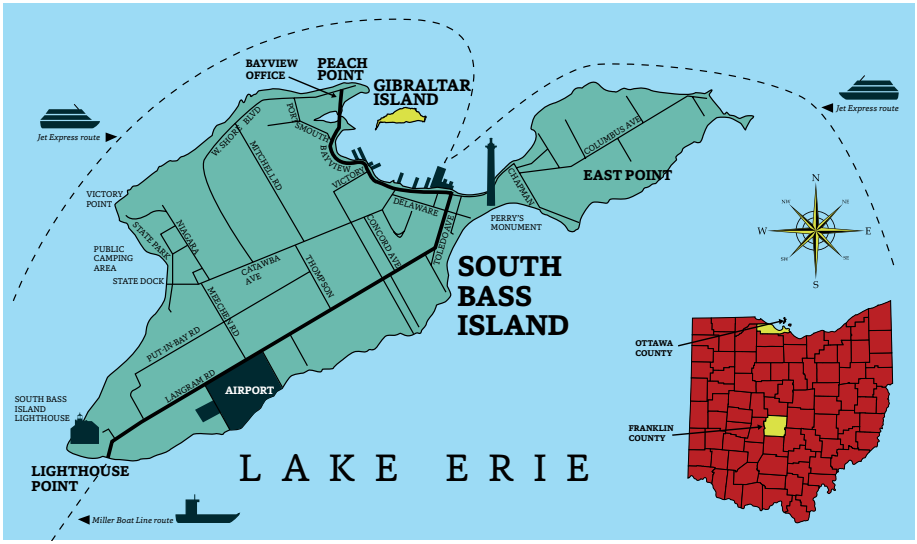
_____ _____

_____ _____

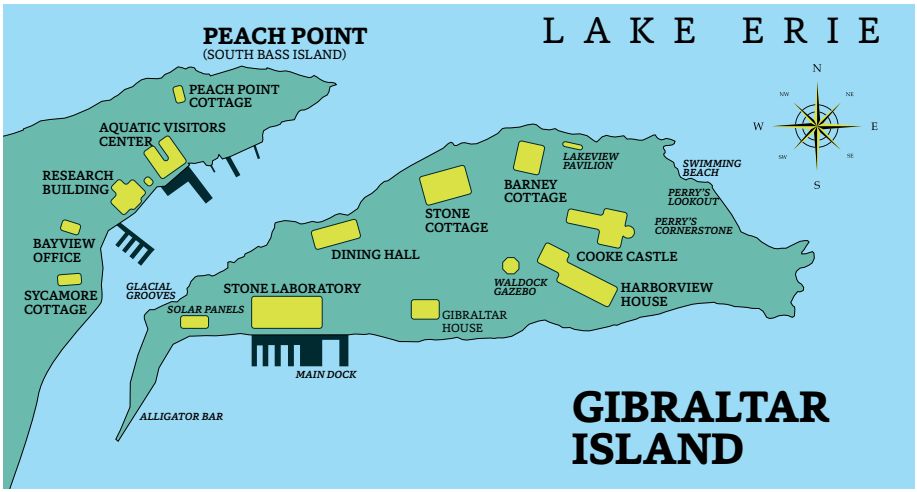
_____ _____

Where in the World Are We?

Stone Lab's global address is: N 41° 40' W 82° 49'



Stone Lab is located on Gibraltar Island in Ottawa County, Ohio. The Bayview Office is situated across Put-in-Bay harbor on South Bass Island's Peach Point. The Ohio Sea Grant and Stone Laboratory administrative and communications office is located in Columbus in Franklin County, Ohio.



The area of Gibraltar is about 6.5 acres (2.6 ha). The highest point of the island is 612 feet (186.5 m) above sea level or about 40 feet (12.2 m) above the average level of Lake Erie.

Interesting Facts About Lake Erie

Here are some Lake Erie facts that aren't widely known. While we don't consider anything about Lake Erie trivial, we suspect that you can stump your friends and astound your parents by turning the interesting facts below into questions.

1. In one season, more traffic passes over Lake Erie than travels through the Panama and Suez Canals combined.

2. Three-fourths of all Great Lakes ship traffic enters Lake Erie ports.

3. Lake Erie is the 10th largest freshwater lake and the 11th largest lake in the world. (The salty Caspian Sea is considered a lake.)

4. Lake Erie has approximately 20 islands depending upon water levels.

5. "Erie" is an Native American word meaning "cat." This name was given to the lake because of the fierce tribe who lived along Erie's shores until the mid 1600s.

6. In 1988 Dr. Seuss changed the wording in his famous book *The Lorax* because of noticable water quality improvements. The line "I hear things are just as bad up in Lake Erie!" is not in newer editions of the book.

7. In a normal year, Lake Erie produces more fish for human consumption than all the other Great Lakes put together.

8. Starve Island in Lake Erie is less than one acre (0.4 ha) of rocks with a few trees. A legend says that a human skeleton was found there, thus the island's name.

9. Lake Erie has the shortest "retention time" of any of the Great Lakes. A drop of water moves through the lake in 2.6 years compared to 191 years in Lake Superior.

10. Lake Erie contains 116 cubic miles (483 km^3) of fresh water. It would take almost 26 Lake Eries to fill Lake Superior's 3,000 cubic mile (12,504 km^3) volume!

11. Lake Erie draws tourists to its beaches because of warm water temperatures. The average water temperature in August is 72° F (22° C) compared to Lakes Michigan and Ontario at 69° F (20° C), Lake Huron at 64° F (18° C) and Lake Superior at 53° F (12° C).

12. At Put-In-Bay in the 1800s, a crew of 70 men could harvest 75 to 100 tons of ice an hour. Harvesting the ice could begin when it was frozen 12-14 inches (30-35 cm) thick. It was then cut into 22-inch (56-cm) blocks.

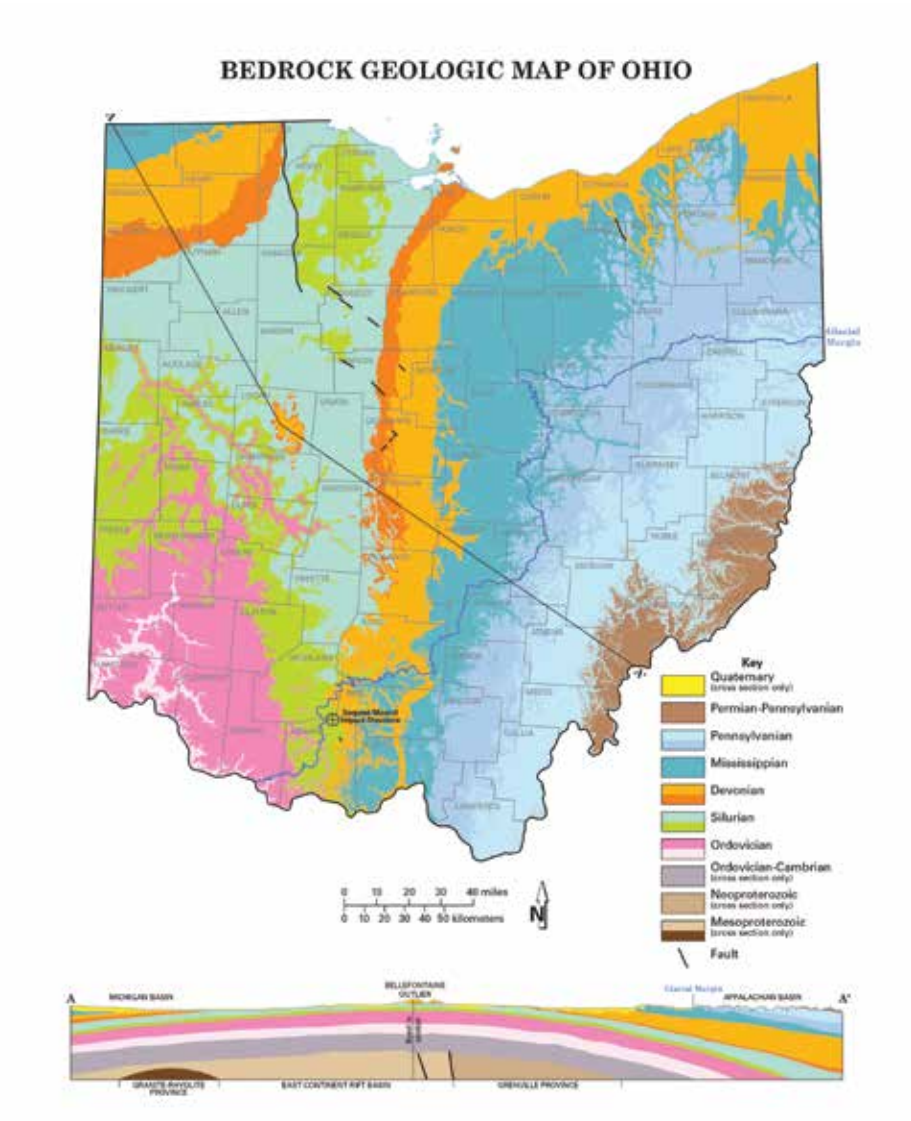
13. In 1814, ships over 100 tons were rare. Today, ships of 1,000 tons or more are common on Lake Erie.

14. Ships loaded in the fresh water of the Great Lakes will rise 6 or 7 inches (15-18 cm) upon entering the ocean due to the difference in densities of freshwater and salt water.

15. The freezing temperature of salt water is lower than fresh water; ocean temperatures must reach -1.8 degrees Celsius (28.8 degrees Fahrenheit) to freeze.

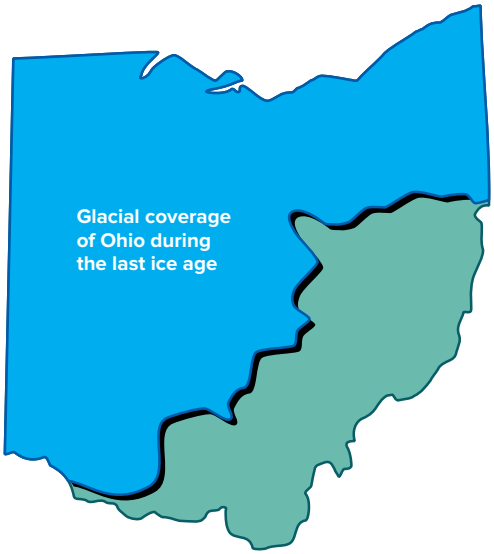
Geology

Geology is the scientific study of the Earth, including rocks and minerals, and the processes by which they form and change. The Great Lakes region has been shaped by the geologic periods of the past and the more recent Ice Ages. For example, a look at the bedrock types found in Ohio shows how geologically active this region has been.



Geology

On this map, the line that separates southeastern Ohio from the rest of the state marks the extent of the glacial coverage in the last Ice Age. Centered near the Hudson Bay region of Canada, glaciers spread over the landscape, creating the Great Lakes and the landscape we find here today. These glaciers left evidence of their presence throughout Ohio, some of which can be found here on Gibraltar Island.



As recently as 15,000 years ago, Gibraltar was under more than 5,000 feet of ice! As the glacial ice moved over the land, rocks and pebbles of all shapes and sizes were trapped and carried hundreds of miles. Over time, these rocks gouged channels in the underlying bedrock below. Today we observe these marks and striations as **glacial grooves**. When the glaciers retreated (melted), they left behind these rocks known as **glacial erratics**. We can easily identify them since they do not match the local bedrock.

Not all of the Lake Erie Islands have the same bedrock. The rock found on the Bass Islands including Gibraltar Island is dolomite, which is a type of limestone with higher concentrations of magnesium. One way dolomite can chemically be distinguished from limestone (the type of rock found on Kelleys Island) is by dripping dilute hydrochloric acid on a fresh rock surface. Limestone will fizz rapidly, releasing bubbles of carbon dioxide gas. Dolomite fizzes, but noticeably less.

Geology

Limestone, and occasionally dolomite, may contain fossils of sea animals that lived in the shallow seas that covered Ohio during the geologic period when rock was formed. Some of the commonly found forms of fossils are pictured here and are of actual size.

Brachiopod

Horn coral

Crinoid stems

Challenge: How many different kinds of **glacial erratics** can you find on Gibraltar Island? Hint: look for different colored rocks on the beaches and along the path leading to the Harborview Dormitory.

Limnology

Limnology is the study of inland waters such as lakes, ponds, and rivers and how they interact with the environment. Limnologists use many branches of science including chemistry, biology, geology and physics to understand the specific body of water they study as a larger system. To do this, they have to use many different types of equipment to collect different types of data.

Limnology Sampling Equipment

Following your Limnology Science Cruise activity, match the following equipment with its use.

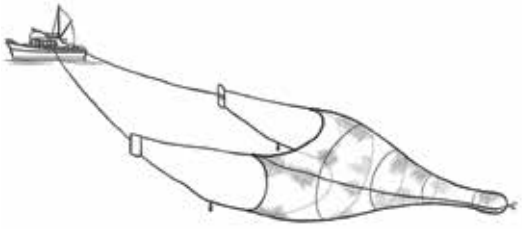
A

B

C

D

E



F

G

Match the equipment with its use:

1. _____ **Ekman dredge:** used to sample soft bottom sediments capturing benthic macroinvertebrates
2. _____ **Thermometer:** used to measure temperature
3. _____ **Plankton net:** used to collect a concentrated sample of free-floating plankton
4. _____ **Bottom trawl:** a large funnel-shaped net towed used to catch fish
5. _____ **Secchi disk:** circular plate used to measure water transparency and estimate the photic zone
6. _____ **Anemometer:** an instrument used for measuring wind speed
7. _____ **Dissolved oxygen meter:** used to measure water temperature and amount of oxygen dissolved in water at various depths

Limnology

Use the following data sheets on your Limnology Science Cruise to gather data about conditions on Lake Erie. The measurements you collect today will be added to a long term data set that allows limnologists to study the lake.

Data Sheet

Sampling Location: _____

Latitude/Longitude: _____

Date: _____ Time: _____ AM/PM

Air Temperature: _____ °C _____ °F | Celsius = 5/9 (F-32) | Fahrenheit = 9/5 C + 32

Wind Direction: _____ Wind Speed: _____ m/s | m/s = mph x 0.447 | mph = m/s ÷ 0.44704

Wave Height: _____

Percent Sunlight: _____ % (an estimate of clear sky versus cloudy)

Station Depth: _____ Meters = _____ cm = _____ feet

Sunlight Penetration

Secchi Depth	_____ cm (going down)
	_____ cm (coming up)
(Total)	_____ cm
(÷ 2 = average)	_____ cm
x 3 = Photic Zone Depth =	_____

*The **photic zone** is the depth which provides the minimum sunlight required by aquatic plant life (1% of the surface light).*

Challenge: Why is photic zone depth important in the lake ecosystem?

Limnology

Dissolved Oxygen Depth Measurements

Depth (m)	Temperature (°C)	Dissolved oxygen (mg/L)
(surface) 0		

Organisms Collected

Plankton: all the microscopic plants and animals that are free floating

(Examples: algae, zooplankton—check your finds on pages 20-21.)

Benthos: bottom-dwelling invertebrates

(Examples: insect larvae, dreissenid mussels, aquatic worms)

Nekton: free-swimming animals

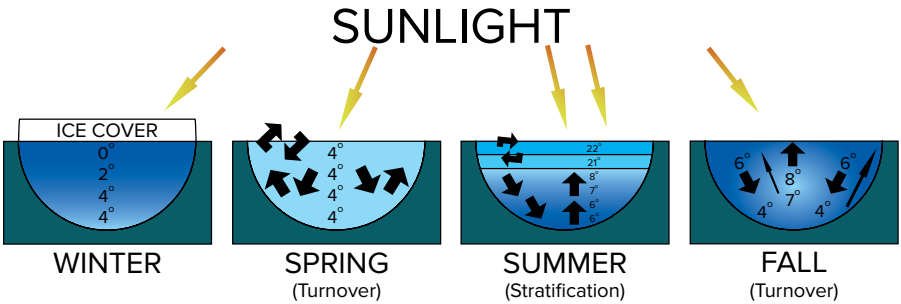
(Examples: all species of fish caught with the trawl)

Climate, Weather and Water Interactions

Ocean temperatures and circulation drive our global climate. In the same way, Lake Erie interacts with the environment to produce locally observed conditions.

1. The weather affects the lake

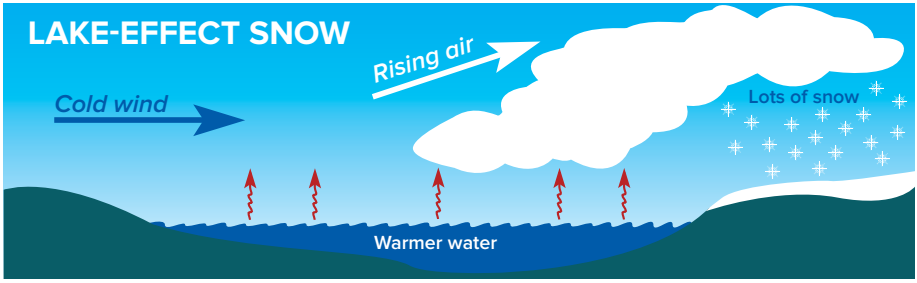
Lakes located in the temperate zones of the earth have seasons which affect water temperature, currents, and ultimately the living plants and animals in the water. Freshwater freezes at 0 degrees Celsius.



Lake Erie is likely to **stratify** (form layers) with different temperatures in the summer. In summer, the top layer or **epilimnion** is the warmest and is constantly being mixed by wind and waves. The bottom or **hypolimnion** is colder and does not easily mix with the surface layer. The dividing layer is called the **thermocline**. It serves as a barrier to mixing due to differing densities of warm and cold water.

2. The lake affects the weather

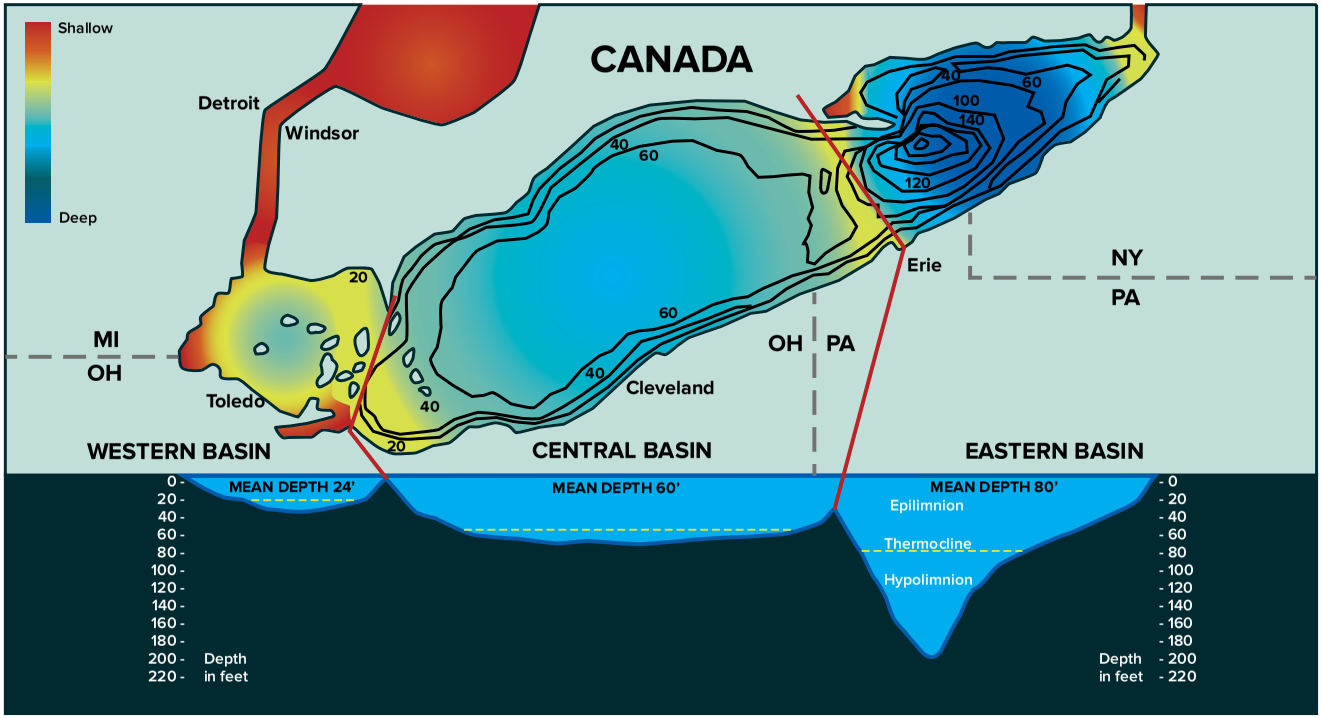
The Great Lakes influence the local climate throughout the entire year. Water temperatures change slower than air or land temperatures. In summer, the water is cooler than the air and acts as a natural air conditioning. In the fall, the warmer water heats the air and extends the growing season. In winter, evaporation off of open water creates lake-effect snowfalls.



Challenge: Did your group find the water temperature pattern you would expect for this season? Y/N

Climate, Weather and Water Interactions

Bathymetric Map of Lake Erie



Lake Erie's Central and Eastern Basins stratify in summer, but the Western Basin is shallower and does not typically stratify. This is biologically important and helps make the Western Basin the most productive part of the lake.

Climate, Weather and Water Interactions

When plants and animals die in the lake, they sink to the bottom and naturally start to decompose. Oxygen is consumed during this process, occasionally leaving the water at the bottom with little to no oxygen. These conditions are called **hypoxia** (low oxygen) and **anoxia** (no oxygen) and can have negative impacts on organisms living in the lake. When lakes stratify, low oxygen water on the bottom does not mix with water on the surface, creating these deadly conditions for benthic organisms. Strong winds and storms can break up these layers, allowing the water to circulate and bring highly oxygenated surface water back to the bottom.

In the recent past, Lake Erie has had unnaturally large amounts of nitrates and phosphates from farm-field runoff and sewage waste. These chemicals act as fertilizers, allowing algae in the lake to become overabundant. As the amount of algae increased, larger areas of anoxic water were formed. This created large areas In the central basin where there was no available oxygen for fish and invertebrates. People along the lake found dead fish, rotting algae, and an unbearable smell that led them to conclude that Lake Erie was dead.

That is only part of the story. Actually, the lake was too much alive! We say that the lake suffered from cultural eutrophication. **Eutrophication**, the addition of nutrients to bodies of water, is a normal process that naturally occurs over hundreds of thousands of years, but the actions of people have sped up this process drastically.

Lake Erie successfully recovered from cultural eutrophication in the 1970s and 1980s through improving sewage treatment, removing phosphates from detergents and by farmers applying less phosphates to their fields. However, since the 2000s, Lake Erie has returned to a eutrophic state due to many factors including population growth, changes in farming practices and an increased frequency of strong storms during spring and early summer. These factors have led to an increase in nutrient runoff in the lake and the return of annual **harmful algal blooms (HABs)**, unusually dense blooms of algae caused by excess amounts of nutrients.

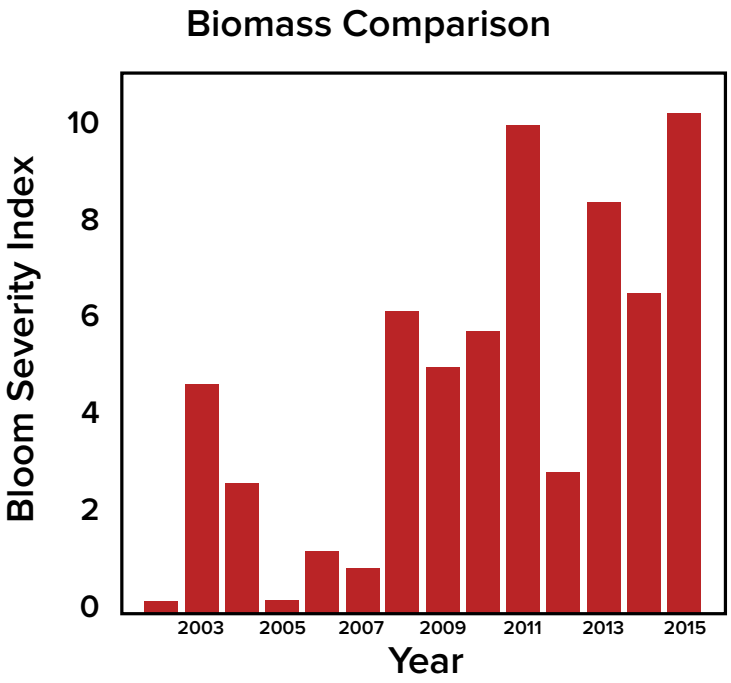
Climate, Weather and Water Interactions

Harmful Algal Blooms

Microcystis is one of the most notable harmful algal blooms happening over the last 10 years. This blue-green alga is a floating cyanobacterium that affects the lake ecosystem as well as the tourists and boaters that visit Lake Erie each year.

The lake has *Microcystis* in it every year, but the concentration varies from year to year due to the nutrient load from Maumee River, which is driven by rainfall.

This figure shows a comparison of the yearly cyanobacteria Bloom Severity Index since 2002, which factors in concentration, duration and spatial coverage.



Credit: Dr. Richard Stumpf, NOAA HAB Bulletin

Plankton

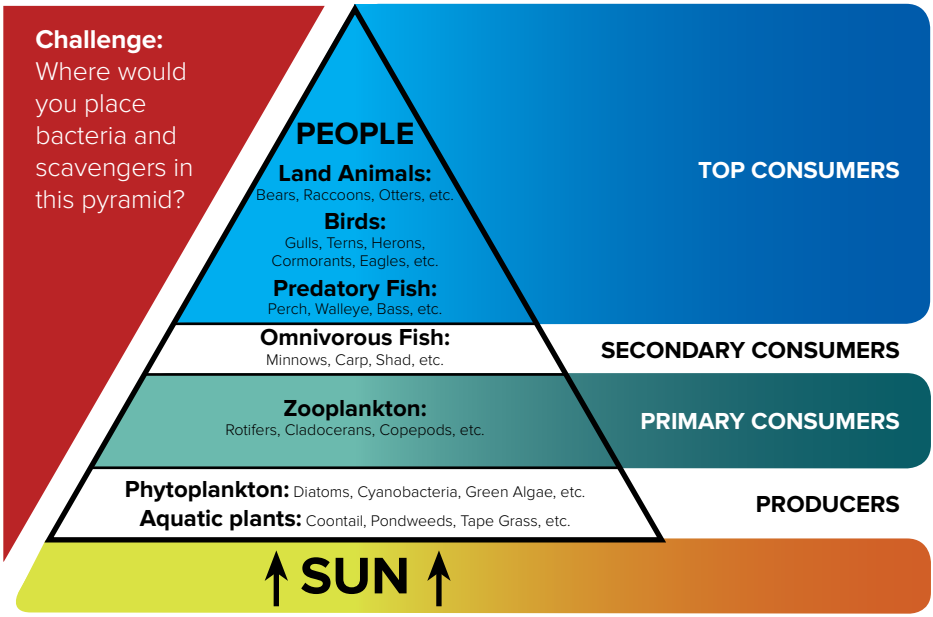
Plankton refers to microscopic life drifting with the movement of the water. Animals that can overcome the currents and move on their own (those that can swim) are classified as **nekton**. Most adult fish in Lake Erie are nekton. **Benthos** refers to life living on the bottom of the lake.

Most plankton are found in the Photic Zone. **Phytoplankton** (plant plankton) are primary producers that use the sun's energy for photosynthesis and produce oxygen just as plants do on land:

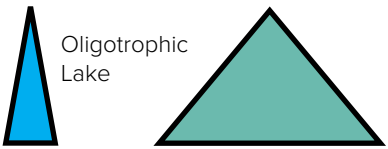
$$6CO_2 + 12H_2O \xrightarrow{\text{SUNLIGHT}} 6H_2O + 6O_2 + C_6H_{12}O_6 \text{ (sugars)}$$

Phytoplankton in oceans and lakes, such as **dinoflagellates**, **cyanobacteria** and **diatoms**, may produce over 50% of the world's oxygen.

Zooplankton (animal plankton) are consumers. They eat other plankton, absorb oxygen from the water, and give off carbon dioxide (CO_2).



A eutrophic lake has a high concentration of phytoplankton. The food pyramid of a eutrophic lake is shown with a large base. A lake that is **oligotrophic** has less algae and phytoplankton and is shown with a "skinny" pyramid base.



Plankton

Common Plankton of Lake Erie

The common types of **phytoplankton** in Lake Erie are blue-green algae (actually cyanobacteria), green algae, diatoms, and dinoflagellates.

The common types of **zooplankton** in Lake Erie are rotifers, cladocerans, copepods, and larvae of larger animals such as fish (ichthyoplankton).
Different populations of plankton will be more abundant during different times of the year. Check the ones you find in your field trip.

Phytoplankton: Blue-Green Algae

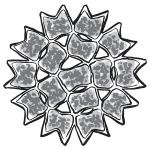
Dolichospermum

Lyngbya

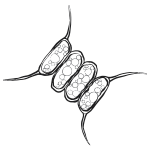
Aphanizomenon

Microcystis

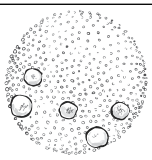
Phytoplankton: Green Algae



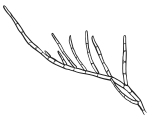
Pediastrum



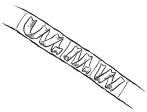
Scenedesmus



Volvox

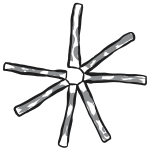


Cladophora



Spirogyra

Phytoplankton: Diatoms

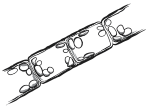


Asterionella

Fragellaria

Tabellaria

Navicula



Aulacoseira

Phytoplankton: Dinoflagellates

Ceratium

Gymnodinium

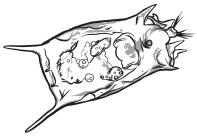
Cryptophytes

Cryptomonas

Plankton

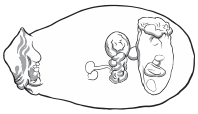
Common Plankton of Lake Erie

Zooplankton: Rotifers

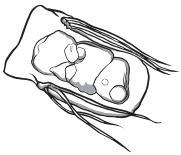


Keratella

Kellicottia



Asplanchna



Polyarthra

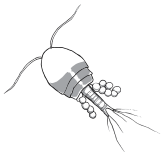
Zooplankton: Cladocerans

Leptodora

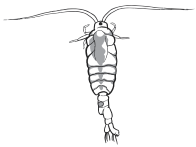
Daphnia

Bosmina

Zooplankton: Copepods (adults)



Cyclopoid



Calanoid

Nauplius (larva)

Zooplankton: Veliger

Dreissenid (zebra or quagga mussel)

Other forms seen (draw)

Macroinvertebrates

Examining the macroinvertebrates living in an area is one way we can assess the water quality of the lake. Using the following macroinvertebrate groupings, calculate the water quality of the sampled area.

Group A (3 points for each kind found):

These organisms are generally intolerant of pollution, so their dominance in the water generally signifies good water quality. They do not survive in polluted water.

Mayfly nymph

Water penny (beetle larva)

Caddisfly nymph

Dobsonfly larva

Stonefly larva

Right-handed gill snail

Group B (2 points for each kind found.):

These organisms can exist in a wide range of water quality conditions.

Dragonfly nymph

Isopod (sow bug)

Damselfly nymph

Amphipod (scud)

Clam

Dreissenid mussel

Cranefly larva

Planaria

Aquatic beetle larva

Crayfish

Group C (1 point for each kind found.):

These organisms are generally tolerant of pollution. Their dominance in the water usually signifies poor water quality.

Leech

Aquatic worm

Blackfly larva

Midge larva

Left-handed pouch snail

Macroinvertebrates

One way to determine the health of an ecosystem is to study the biotic indicators living in an area. Biotic indicators are plants or animals that are susceptible to specific levels of pollutants. **Macroinvertebrates** are animals without an internal skeleton or backbone, and are good biotic indicators of water quality (examples include larval insects, mussels and crayfish).

Use the scientific method to study water quality

Question and Hypothesis: What do you think the water quality is around Gibraltar Island? Why? (Circle your educated guess)

Poor / Fair / Good / Excellent

Methods: Collect your sample of macroinvertebrates using nets and traps. Score the sample collected using page 22.

Group A____ x 3 = ____; Group B ____ x 2 = ____; Group C____ x 1 = _____.

Add the group totals to get the Cumulative Index Value. _____

Compare the value with the following chart to find the water quality. Circle today's quality:

CUMULATIVE INDEX VALUE	WATER QUALITY ASSESSMENT
23 or more	Excellent
17 – 22	Good
11 – 16	Fair
10 or less	Poor

Conclusion: What was water quality using this technique? (Circle your findings)

Poor / Fair / Good / Excellent

Discussion: Did your findings match your hypothesis? Why or why not? What are some other factors influencing macroinvertebrate populations around Gibraltar?

_____

_____

Modified from Ohio Department of Natural Resources, Division of Natural Areas and Preserves, "Ohio Scenic River Stream Quality Monitoring: A Citizens Action Program."

Ichthyology

Ichthyology is the scientific study of fishes. There are more than 100 different species of fish in Lake Erie, which are scientifically grouped together according to family characteristics. Ichthyologists can determine what family a fish is grouped in by looking at several different external features such as tail shape and scale type using a **dichotomous key**.

Scientific Classification System: A system of categorizing all living things based on similar characteristics. This process is also often referred to as "taxonomy." The highest (or broadest) division in the system is called a "Kingdom" and the lowest (or most specific) is called a "species." When identifying specific organisms, scientists use both the genus and species to form the scientific name, which must be written in italics or underlined.

Largemouth Bass Taxonomy

Kingdom—Animalia

Phylum—Chordata

Class—Actinopterygii

Order—Perciformes

Family—Centrachidae

Genus—*Micropterus*

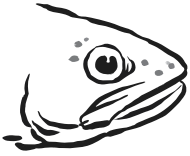
Species–*Micropterus salmoides*

Ichthyology

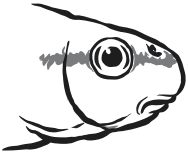
External Characteristics of Bony Fish

Mouth Positions

Superior



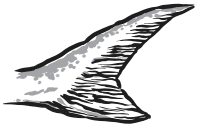
Terminal



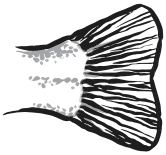
Subterminal

Inferior

Tail Types



Heterocercal

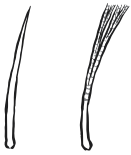


Homocercal

Homocercal: Forked

Homocercal: Square

Fin Features



Spine (l) Ray (r)

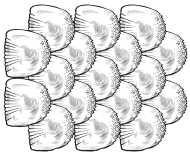
Anal Fin

Scale Types

Ctenoid

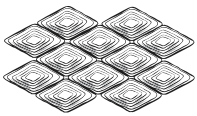
Cycloid

Ganoid



Ctenoid

Cycloid



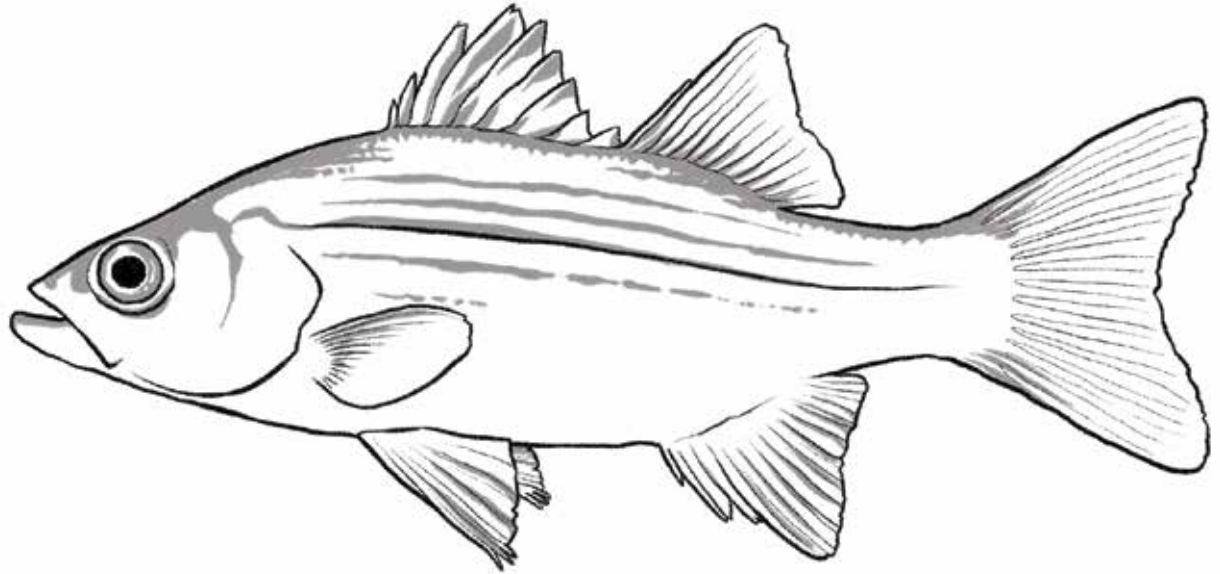
Ganoid

Ichthyology

External Characteristics of Bony Fish

Using the word bank below, label the external characters of the fish.

Word bank: lateral line, mouth, eye, caudal fin, pectoral fin, spiny dorsal fin, soft dorsal fin, pelvic fin, anal fin, gill cover



Challenges: Draw an adipose fin and barbels on this fish.

What type of mouth does this fish have? _____ What type of tail does this fish have? _____

Ichthyology

Common Fish Families of Lake Erie

There are more than 20 families of fish in Lake Erie.
Here are some of the more common fish families you will see in the trawl or in the lab.

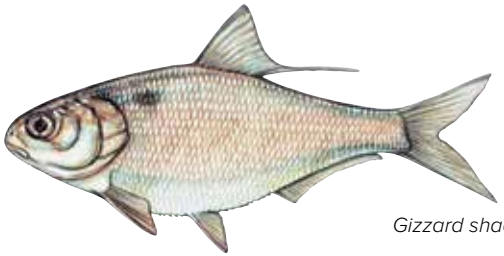
Lamprey family (Petromyzontidae)

These are primitive fish that have no jaws or calcified bones. Their mouths are toothy, sucker-like discs. Many species, like the non-native sea lamprey, are parasitic on other fishes. Native lampreys should not be considered a threat to other fishes.

Sea lamprey

Herring family (Clupeidae)

Herrings include the gizzard shad and alewife, also known as “sawbellies” for their jagged undersides. They feed on plankton and are an important prey of larger fish such as walleyes. They may die off in large numbers as water temperatures change with the seasons.



Gizzard shad

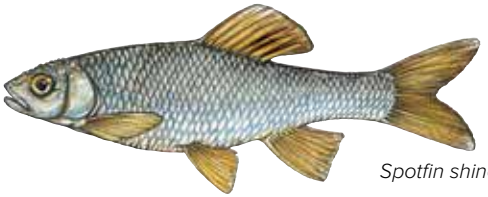
Trout, salmon and whitefish family (Salmonidae)

All of these fish have an extra fatty fin called the adipose fin. Steelhead trout are not native to Lake Erie and are stocked for anglers to catch.

Steelhead trout

Minnow family (Cyprinidae)

Minnows, shiners and chubs are important as food for many larger fish, and they are widely used as bait. The family also includes carp and goldfish!



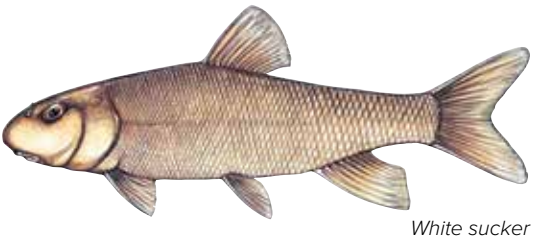
Spotfin shiner

Ichthyology

Common Fish Families of Lake Erie

Sucker family (Catostomidae)

Suckers are a lot like minnows, but most have a strongly subterminal, downward-pointed mouth and fleshy "sucker" lips. Some suckers, like the quillback and buffalofishes, can get 2-3 feet long.



White sucker

Catfish family (Ictaluridae)

Catfishes have no scales, and their barbels are like feelers to help them find food. Catfishes eat both plants and animals that they find on or in the bottom of lakes and streams.

Channel catfish

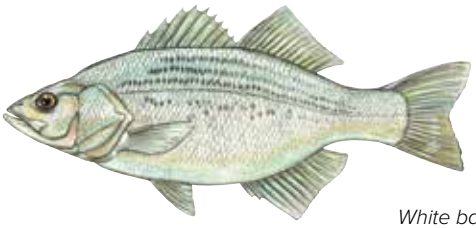
Trout-perch family (Percopsidae)

Trout-perch have rough scales. They also have an adipose fin like trout and a general shape like a perch. Many other fish eat trout-perch.

Trout-perch

Temperate basses (Moronidae)

The white bass and white perch live over sand and gravel bottoms or around reefs in open water. They feed on smaller fish, including their own young.



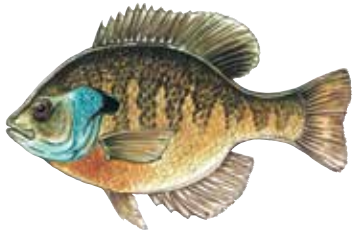
White bass

Ichthyology

Common Fish Families of Lake Erie

Sunfish family (Centrarchidae)

Many types of fish are in this family, from largemouth and smallmouth bass to bluegill. They eat smaller fish, frogs, and macroinvertebrates such as crayfish and insects.



Bluegill

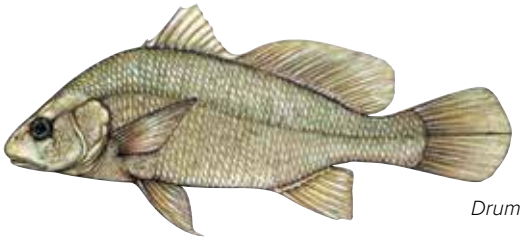
Perch family (Percidae)

This group includes the walleye, yellow perch and darters. Walleye live in cold, clear water, but perch can live in warmer water.

Yellow perch

Drum family (Sciaenidae)

These fish get their name from the drumming sound they make. Some people call this fish "sheepshead." They eat crayfish, aquatic insects and small fish.



Drum

Goby family (Gobiidae)

The round and tube-nose gobies are accidental imports, presumably from the ballast tanks of ships coming from overseas. They have a unique fused pelvic fin which acts as a suction cup to attach to rocks.

Round goby

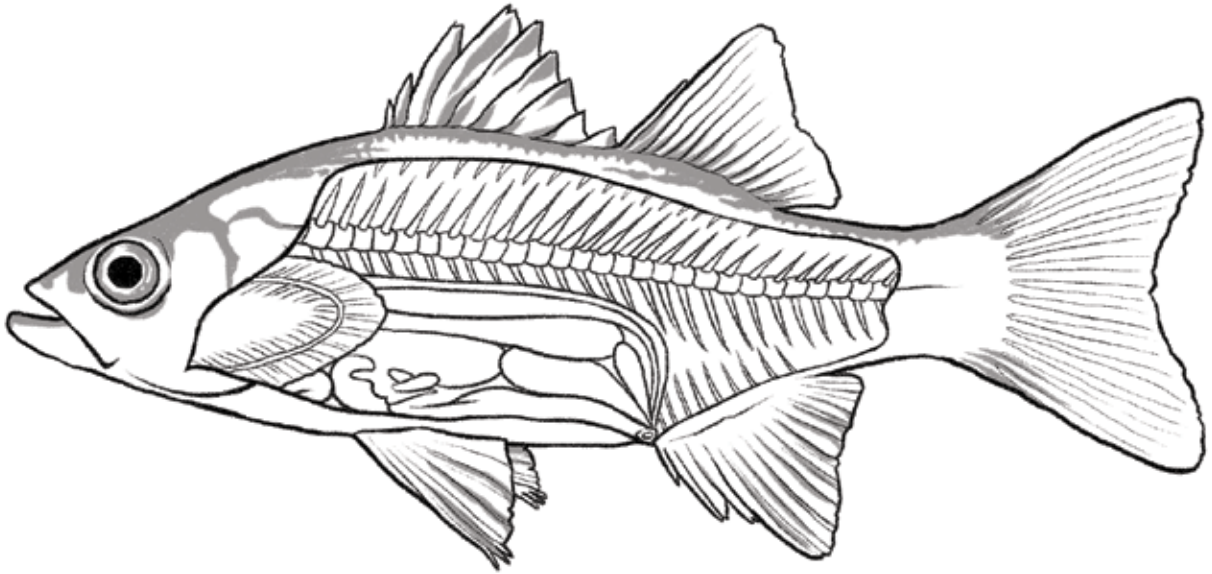
Challenge: Draw a star next to the fish families you identified in lab using the dichotomous key.

Ichthyology

Fish Dissection Guide

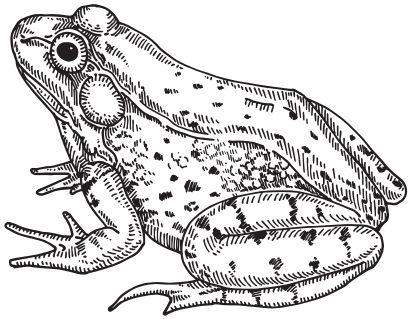
Using the word bank below, label the internal anatomy of the fish.

Word bank: stomach, liver, swim bladder, intestine, spleen, gonad, heart, gallbladder, gills, gill rakers, anus



Herpetology

Herpetology is the scientific study of reptiles and amphibians. These two groups of organisms have been historically grouped together for study despite some major differences between them. However, they both are referred to as "cold blooded", or more appropriately, **ectothermic**, which means they require an external source of energy like the sun to warm themselves.

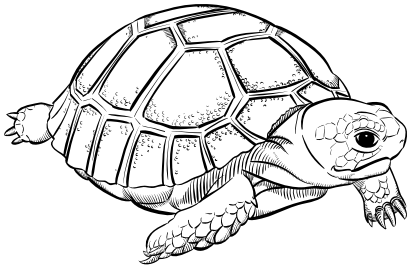


Amphibians

Examples of amphibians include frogs, toads, salamanders

Characteristics include:

- moist skin
- no claws
- soft, gelatinous eggs that require water
- reproduction is usually through **metamorphosis**



Reptiles

Examples of reptiles include alligators, snakes, lizards, turtles

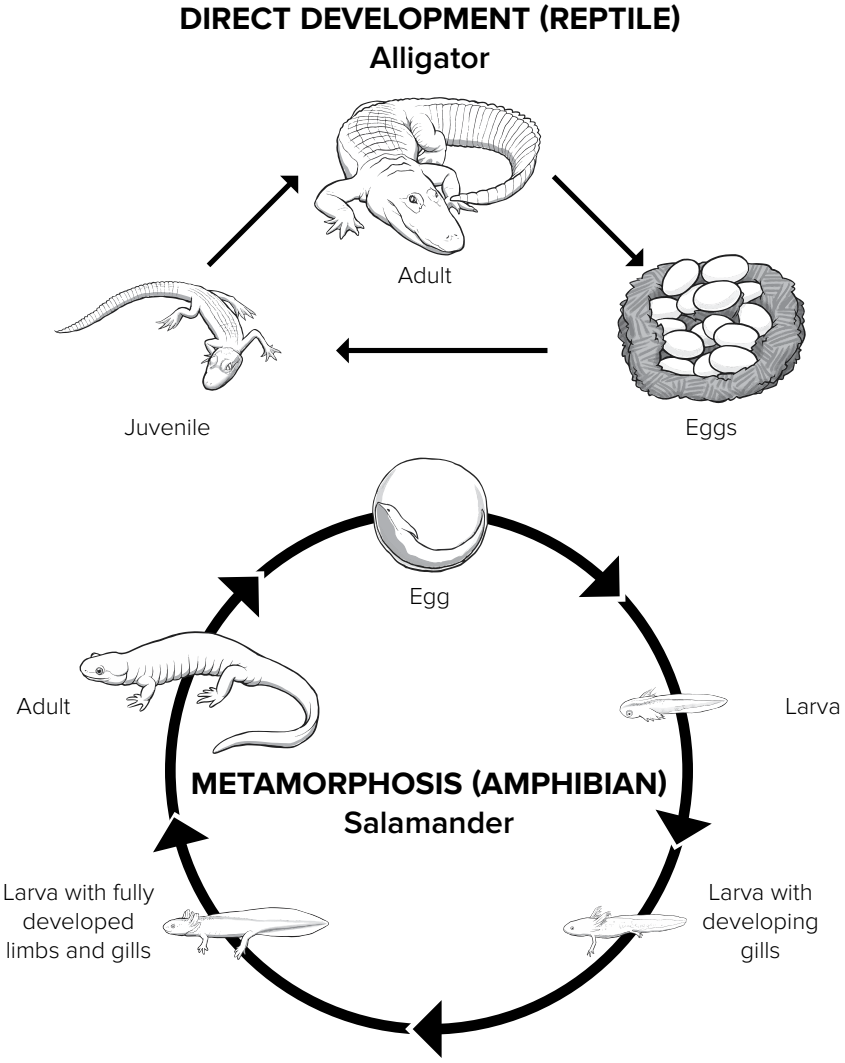
Characteristics include:

- dry, scaly skin
- claws on feet
- leathery eggs
- reproduction is through **direct development**

Herpetology

Direct Development vs. Metamorphosis

Reptiles reproduce by direct development where the young animal is born as a smaller version of the adult (ex: alligators). Most amphibians reproduce by metamorphosis, where the young animal starts its life in a larval stage before slowly changing into the final adult form (ex: salamanders).



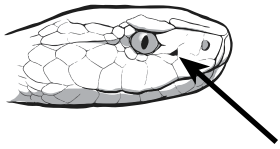
Herpetology

Venomous Snakes in Ohio

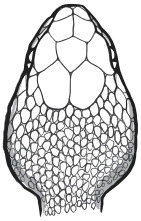
In general, most snakes are harmless nonvenomous species. However, three venomous snakes are found in Ohio: the Eastern Massasauga, the Northern Copperhead and the Timber Rattlesnake. Venomous snakes have several external characters that can help identify them from nonvenomous species. However, you should practice a "look but don't touch" policy with all wild snakes since most will still bite if they feel threatened.

VENOMOUS SNAKES

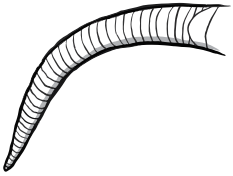
Characteristics of venomous species include a distinctly triangular head, the presence of heat sensing pits, elliptical pupils and undivided anal scales.



side



top

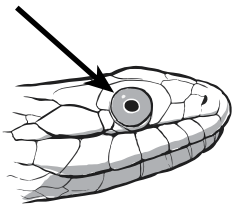


ventral side of tail

Cottonmouth

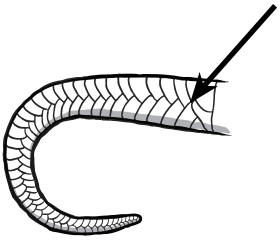
NONVENOMOUS SNAKES

Characteristics of nonvenomous species include a more rounded head, no heat sensing pits, rounded pupils and divided anal scales.



side

top



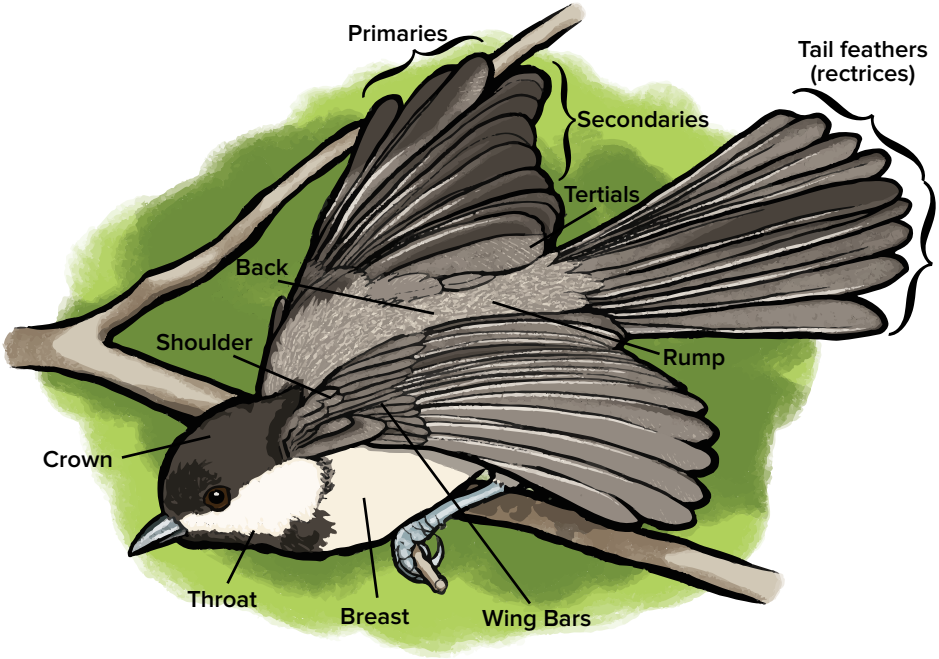
ventral side of tail

Watersnake

Ornithology

Ornithology is the study of birds. To better understand the types of birds, the habitats they live in or the foods they eat, ornithologists look at several different external characteristics. For example, looking at the drawing of the bird pictured below, an ornithologist could tell by looking at its beak that it likely eats small seeds and insects.

Distinguishing Characteristics of Birds

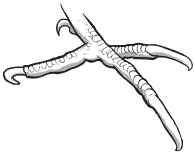


Foot Types

Perching: used for grasping twigs and branches

Cardinal

Climbing: used for clinging and climbing on the trunks of trees



Woodpecker

Webbed: used for swimming

Duck

Talon: used for grasping and tearing

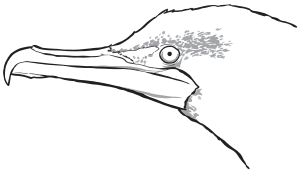
Eagle

Ornithology

Distinguishing Characteristics of Birds

Beak Types

Hooked: used for tearing flesh; carnivore



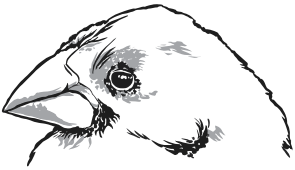
Cormorant

Eagle

Hammer: type used to drilling holes in bark; insectivore

Woodpecker

Conical: used to crack hard seeds; herbivore

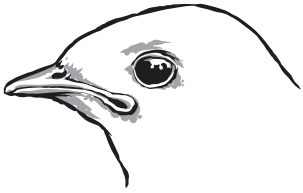


Finch

Spatulate: used to eat plants and insects; omnivore

Duck

Aerial: Used to trap flying insects; insectivore



Swallow

Ornithology

Bird Observation Checklist

Use the checklist below to record the birds you see on your hike around Gibraltar Island. Remember to look for identifying characteristics that might tell you more about the birds you see during your observations.

Waterfowl
- ❑ Mallard Duck
- ❑ Bufflehead Duck
- ❑ Red-Breasted Merganser
- ❑ Canada Goose
- ❑ Swan
- ❑ Wood Duck
- ❑ Other _____

Birds of Prey
- ❑ Red-Tailed Hawk
- ❑ Bald Eagle
- ❑ Osprey
- ❑ Cooper's Hawk
- ❑ American Kestrel

Herons
- ❑ Great Blue Heron
- ❑ Green Heron
- ❑ Black-Crowned Night-Heron
- ❑ Snowy Egret

Gulls
- ❑ Ring-Billed Gull
- ❑ Herring Gull
- ❑ Bonaparte's Gull
- ❑ Great Black-Backed Gull

Terns
- ❑ Caspian Tern
- ❑ Common Tern

Woodpeckers
- ❑ Northern (Yellow-Shafted) Flicker
- ❑ Downy Woodpecker
- ❑ Red-Bellied Woodpecker

Owls
- ❑ Great Horned Owl
- ❑ Screech Owl

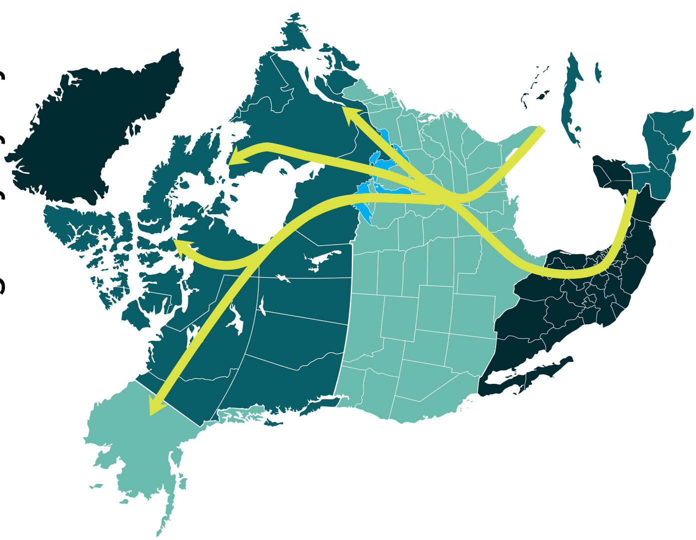
Pigeons & Doves
- ❑ Mourning Dove
- ❑ Rock Dove (Common Pigeon)

Perching Birds
- ❑ Yellow-Rumped Warbler
- ❑ Yellow Warbler
- ❑ Magnolia Warbler
- ❑ American Robin
- ❑ Red-Winged Blackbird
- ❑ Common Crow
- ❑ Blue Jay
- ❑ Barn Swallow
- ❑ Tree Swallow
- ❑ Northern Cardinal
- ❑ House Finch
- ❑ Purple Finch
- ❑ American Goldfinch
- ❑ English Sparrow (House Sparrow)
- ❑ Song Sparrow
- ❑ White-Throated Sparrow
- ❑ White-Crowned Sparrow
- ❑ Baltimore Oriole
- ❑ House Wren
- ❑ Brown Creeper
- ❑ White-Breasted Nuthatch
- ❑ European Starling
- ❑ Common Grackle
- ❑ Red-Eyed Vireo
- ❑ Eastern Kingbird
- ❑ Other _____
- ❑ Other _____

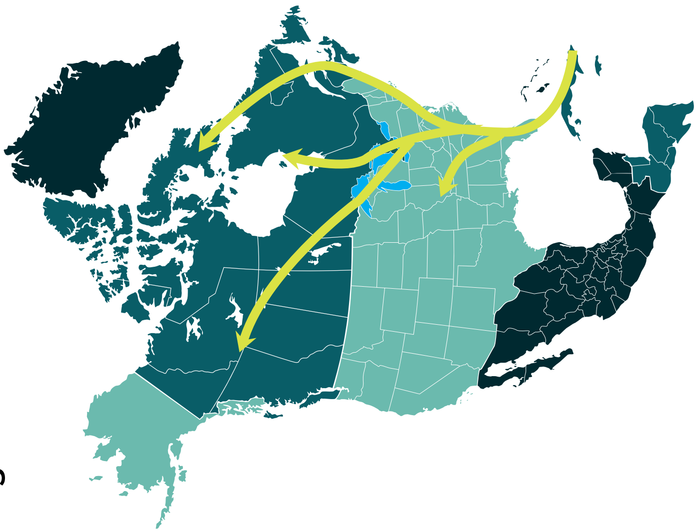
Others
- ❑ Coot
- ❑ Belted Kingfisher
- ❑ Turkey Vulture
- ❑ Chimney Swift
- ❑ Ruby-Throated Hummingbird
- ❑ Double-Crested Cormorant

Ornithology

Migratory Flyways Crossing the Great Lakes



Missisipi Flyway



Atlantic Flyway

The general paths that birds follow during migration are known as flyways. The majority of birds we see on the Lake Erie islands use either the Mississippi or Atlantic flyway. Some birds will stay in this area to nest, while others are only stopping briefly to eat and rest before moving on to their final destinations.

Challenge: How many different bill types were observed?

How many different foot types were observed?

What other types of evidence of birds were found during your hike?

Glossary

Anoxia: The total depletion of oxygen in an area of water at the bottom of the lake.

Benthos: Bottom-living organisms (adjective: benthic).

Biotic: Pertaining to, or produced by life or living organisms.

Biotic Indicators: Species that can be used to monitor the health of an environment or ecosystem.

Brachiopod: Benthic marine bivalves. During the Paleozoic Era they dominated the sea floors and may be the most plentiful fossil on earth.

Climate: The average weather conditions in an area over a long period of time. May include seasonality.

Climate Change: The change in global climate patterns attributed largely to the increase in carbon dioxide released by the burning of fossil fuels.

Crinoid: Marine organisms which have a skeleton made up of calcareous (containing lime) plates. Most fossil crinoids lived attached to the sea-floor by a flexible stem which are the fossil we see today.

Cyanobacteria: Blue-green algae; bacteria that photosynthesize.

Dichotomous Key: A key used for identification of organisms based on a series of choices of different characteristics each leading in a direction to another characteristic until the organism is identified.

Direct Development: An organism that is born in the same form as the adult organism and does not go through metamorphosis.

Dolomite: A carbonate mineral composed of calcium magnesium carbonate CaMg(CO3)2. Dolomite is the bedrock of the Bass Islands.

Ectothermic: "Cold-blooded" animals that need to use a heat source such as the sun to keep warm.

Epilimnion: The top layer of water in a stratified lake.

Eutrophic: Lake conditions that offer an abundance of nutrients to sustain life often indicated by green, murky water.

Eutrophication: The term eutrophic means 'well-nourished.' Eutrophication is the addition of nutrients to bodies of water and the resulting effects.

Geology: The study of the earth.

Glacial Grooves: Gouges carved in bedrock by boulders and large rocks, caused by moving glaciers.

Glacial Erratics: Rocks not native to the region left behind after a glacier retreat or melts.

Glossary

Harmful Algal Blooms (HABs): Unusually dense blooms of algae caused by excess amounts of nutrients (phosphorus and nitrogen) in the water. Some blooms can produce toxins that can affect the health of humans, pets, livestock, fish and other wildlife.

Herpetology: The study of amphibians and reptiles.

Horn Coral: An extinct order of corals that grew in a long cone shape structure much like the horn of a cow.

Hypolimnion: The bottom layer of water in a stratified lake.

Hypoxia: Low levels of oxygen in an area of water at the bottom of the lake.

Ichthyology: The study of fish.

Invasive Species: A plant or animal that is alien (non-native) to an ecosystem. Their introduction is likely to cause economic, human health, or environmental damage.

Limnology: The study of inland waters such as lakes, rivers and wetlands.

Macroinvertebrates: Animals without backbones that are large enough to be seen by the naked eye.

Metamorphosis: Development of a young organism to an adult organism that includes at least two stages of development.

Nekton: Free swimming animals such as fish.

Oligotrophic: Lake conditions that offer little nutrients to sustain life often indicated by clear, transparent water.

Ornithology: The study of birds.

Photic Zone: The layer in a lake which provides a sustaining amount of sunlight for aquatic plants.

Phytoplankton: Microscopic plants that drift with the movements of the water.

Plankton: All living things (plants, animals, fungi, bacteria etc.) that drift with the movements of the water and cannot swim strongly on their own. Typically microscopic.

Stratify: To form layers.

Striations: Scratches or gouges cut into bedrock by glacial abrasion.

Thermocline: The dividing layer between the top (Epilimion) and bottom (Hypolimion) layers of water of a lake where temperature changes drastically with depth. The thermocline can also create a barrier to mixing.

Weather: The current state of the atmosphere with respect to wind, temperature, cloudiness, moisture, and air pressure.

Zooplankton: Microscopic animals that drift with the movements of the water.

Notes

Notes

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