Dirty Little Secrets

Foundations From the Past

Introduction

In the early 1920s, construction began on a new city center complex we now know as Tower City in Cleveland, Ohio. At the time, engineers were faced with building a 52-story tower, which would become the tallest building outside of New York City. Not having the kinds of tools we use today to determine how to support such a structure, they used what was available to them: deep earth core samples. These samples were taken from the exact site of the building, as well as other areas in the vicinity. The samples were meticulously labeled and charted, and helped the engineers to locate the bedrock layer of sediment upon which the building would rest.

Recovered only recently by a team of local geologists, paleontologists and glaciologists at Cleveland State University (CSU) and The University of Akron (UA), these samples hold the region's geologic record of events over a 20,000-year period.

Dirty Little Secrets: Foundations from the Past, a PBS 45 & 49 production, reports on the joint scientific project underway by scientists at UA and CSU. The team's research includes looking at how old the various layers are; studying variations in water levels of both Lake Erie and the Cuyahoga River; and determining what clues the vegetation holds about climate, water temperatures and the greenhouse effect.

The core samples taken in the 1920s were kept by the Cleveland Union Terminal Company (the company that was building the new tower), and were then passed on to what is now the Tower City Archives. In 1999, the archivists decided they no longer needed to retain these samples, and they were donated to Mike Tevesz, professor at Cleveland State University. Tevesz put together a multi-disciplinary team to study the samples to see what information they could uncover in regards to the history of the Cleveland area and its relationship to Lake Erie. In addition, the results of these studies will reveal information regarding the glacial activity of the area and help in the prediction of future weather patterns.

"It's a real scientific treasure," said paleontologist and research team leader Tevesz. "As you go down the sediment, you go back in time. It's like turning back the pages of history."

The team includes:

- **Michael J. Tevesz**, Ph.D., Professor, Cleveland State University Department of Biological, Geological and Environment Sciences. http://bgesweb.artscipub.csuohio.edu/faculty/tevesz.htm
- **John Szabo**, Ph.D., Professor and Chair, The University of Akron Department of Geology. http://www3.uakron.edu/directory/staff/search.cgi?state=dosearch&uid=jpszabo&ou=Geology
- **William C. Barrow**, Cleveland State University Special Collections Librarian. http://www.csuohio.edu/CUT/wcb2.htm
- **Nate Fuller**, Geologist, State of Ohio Department of Natural Resources, Division of Geological Survey, Lake Erie Geology Group. http://walrus.wr.usgs.gov/infobank/g/g192le/html/g-1-92-le.meta.html
- **David Ball**, Ph.D., Associate Professor of Chemistry, Cleveland State University. http://www.osc.edu/research/spotlight/ball/ball.shtml
- **Kristine Bradley**, Graduate Student, The University of Akron Department of Geology
- **Mark Tumeo**, Ph.D., Interim Dean, Cleveland State University, College of Graduate Studies and Research. http://bgesweb.artscipub.csuohio.edu/faculty/tumeo.htm

Lake Erie

Facts

- Lake Erie derived its name from the Erie Indians who occupied the southern shore at one time.
- Early French writers called Lake Erie Lac du Chat or Lake of the Cat, after the "cat." Some people believe this name reflects the wildcats or panthers in the area.
- Lake Erie is the eleventh largest lake in the world (by surface area) and the fourth largest of the Great Lakes (by surface area).
- Lake Erie is the smallest of the Great Lakes by volume.
- Lake Erie is the shallowest of the Great Lakes.
- 95% of the inflowing water comes via the Detroit River and from the "upper lakes." The rest comes from precipitation.
- Lake Erie drains into the Niagra River.
- The Aragon River Valley became Lake Erie after the retreat of the glacier.
- Lake Erie is the warmest and most biologically productive of the Great Lakes.
- Lake Erie is considered the best in the world when it comes to fishing for walleye.
- Lake Erie is 241 miles long and 57 miles wide.
- The average depth of Lake Erie is 62 ft. The maximum depth is 210 feet.
- There is 116 cubic miles of water in the lake.
- There is 871 miles of shoreline (including islands).
- The Great Lakes hold 20% or 1/5 of the fresh water on the surface of the Earth.

Sources:

- Great Lakes Atlas, Environment Canada and U.S. Environmental Protection Agency, 1955 at http://www.great-lakes.net/lakes/ref/eriefact.html
- Great Lakes Atlas, Environment Canada and U.S. Environmental Protection Agency, Lake Erie brochure, 1990.
- **Dirty Little Secrets: Foundations From the Past** —a PBS 45 & 49 video production.

Formation

The foundation of the total area known as the Great Lakes was laid about 3 billion years ago during the Precambrian Era. During that era, great stresses caused volcanic activity and great mountain formation. Sedimentary rocks and volcanic rock were heated and folded into complex structures and then folded and eroded. In the northeastern part of North America, gentle hills and small mountains developed and became known as the Canadian Shield (also called the Precambrian Shield or the Laurentian Plateau).

The Canadian Shield is a 1.9 million-square-mile, horseshoe-shaped region that covers central and eastern Canada and a little of the Northeast United States. The Shield, which accounts for about half of the area of Canada, is made up of hard, crystalline rocks — among the oldest in the world.

Lake Erie

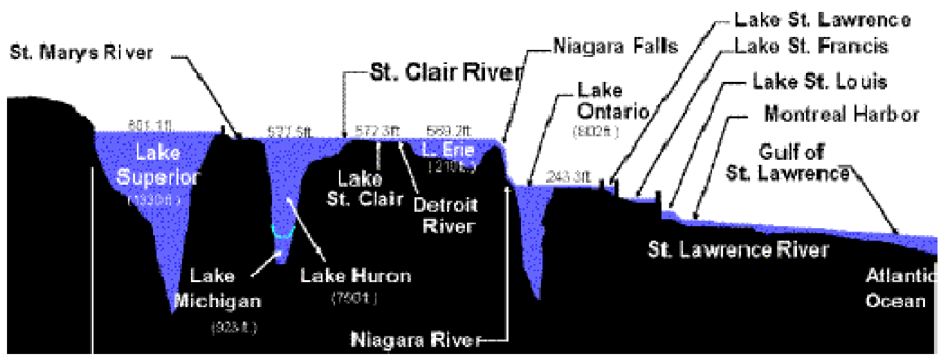
Glaciers

The most recent Ice Age began about 2.5 million years ago. During this time, a continental ice sheet covered the region that developed into glaciers. There were at least four glaciations during this time: the Nebraskan (1million years ago); the Kansan (700,000 years ago); the Illinoian (about 225,000 years ago); and the Wisconsin (about 22,000 years ago).

A “likely scenario” for the formation of the glaciers (called the “lake effect” theory) is that the Arctic ice cap melted, but the Arctic remained cold. This caused a “lake effect” snow that blanketed the area with snow for many years. The snow became a “mile-high sheet of ice” and stayed in place for 100,000 years. (The snow stopped only when the Arctic Ocean froze again.)

This accumulation of snow had tremendous weight and caused the lower layers of ice to be in a “plastic state” and to move away from the center of the accumulation. Lobes of ice moved forward and then retreated back from different centers and in different directions. The lobes carried different material, depositing rock debris in a variety of locations. Often the tip of the ice lobe melted, but the ice was pushed ahead. This meant that in some locations there was considerable debris deposited resulting in a range of great hills (terminal moraines).

Because the land was greatly depressed, large glacial lakes formed (much larger than the current Great Lakes). As the glacier retreated, the land began to rise The major flow patterns and general configuration of the Great Lakes were fixed about 5,000 years ago.



This theory does not give a satisfactory explanation of what caused the end of the Ice Age. It is believed that the “ocean currents theory” better explains the end. These theories are based upon what “geologists call the ‘Principle of Uniformitarianism,’ where the present effects of several geologic agents are used to interpret the happenings of the past” (Door and Eschman, 1970).

Hotlist:

- **Natural Process in the Great Lakes: Geology:** http://www.epa.gov/glnpo/atlas/glat-ch2.html
- **Canadian Shield** (you must type Canadian Shield in the search box): http://encarta.msn.com/encnet/features/reference.aspx
- **Geology of Lake Erie:** http://www.avonhistory.org/hist/lakes1.htm
- **GL/GL Land/River Valleys:** http://earthsys.ag.ohio-state.edu/project/Glland/river_valley/river_valley

The Terminal Tower

Before the Terminal Tower

Let's step back in time! It's 1910. You have business in Cleveland but live far away. Let's think about our trip. How would you get to Cleveland? What would you see?

You would probably have come by train. You would have been dropped off at 15 different locations, depending upon which train you chose to ride. If you were let off around midtown, you would have walked to Public Square. This was where the Cleveland trolley lines met. Or you might have taken an interurban — a self-propelled electric railway car. (There were over 2,000 miles of tracks for this electrified railway car in Ohio at the time.)

Where the Terminal Tower now stands was once a collection of old buildings "covered with rust, soot and advertising, which bore witness to Cleveland's first mercantile age" (http://www.csuohio.edu/CUT/gamut1.htm). You would have seen the Old Stone Church (1855) and the Society of Savings Bank (1889). You would also have seen the construction of the new Federal Building (1893) and the Williamson Building (1900). (These buildings were both demolished in 1982 to make way for the Sohio (currently called BP America) headquarters. You might also have seen the Soldiers' and Sailors' Monument.

Buildings removed on North Broadway.
(CSU Library Archive)

Buildings removed from West Ontario
(CSU Library Archive)

To see more of these scenes, go to http://www.csuohio.edu/CUT/gamutill.htm and view some of the photos.

Planning the Terminal Tower Complex

Public Square had been the center of civic life in Cleveland. Beginning in the early 1890s there had been a movement afoot to centralize federal, county and city governments. All needed new, larger buildings and the Public Square site was proposed as the site for these buildings. They planned a "civic center" that ran from Public Square to Lake Erie. This represented a redevelopment of the core of the city. The people were reluctant to pay for this due to other practical problems they felt needed to be addressed. Also part of this plan was a new lakefront railroad station. The Pennsylvania and New York Central Railroads were to pay the city $1 million for the site but World War I caused a postponement in the plan.

The Van Sweringen brothers had purchased land in Shaker Heights for a housing development. They decided that if the move to the suburbs were to succeed, train connections needed to be available. After much debate the location was changed to the current site of the Terminal Tower. In 1919, the Pennsylvania Railroad withdrew from the project. In 1922, Oris Van Sweringen opened an office for design and construction of the new building. Engineering expenses were high because of the large number of studies required for various parts of the project. One of these studies is the core sample study discussed in another section of this teachers guide.

After much "inside" manipulation resulting in the change in location from the lakefront to the "mall," the brothers Oris Paxton and Mantis James Van Sweringen announced their plans in 1923 to build a building to compare to the Woolworth Building in New York City. A decision was made to raise the tower to increase office space.

The Terminal Tower

Construction

Besides the increased office space of the new Terminal Tower building, the 52-story height is visually important to Cleveland. It was no longer to be just an accent to the train station, but also an aesthetically appealing addition — a visage people would remember. It provides an anchor to the observer.

Because of the height of the tower, it was decided that it should sit on bedrock as a foundation. In 1926, 16 caissons (underground poles that sit on the bedrock and give strength to the building) each went down 200-250 feet to support the weight of the building. It was also necessary to design the buildings so that there wouldn't be unnecessary vibrations from the trains below or from traffic on the street. During this time, the project underwent a continual process of planning, rethinking and changing plans.

Construction was completed in 1930. The usefulness of the train station below was short-lived as cars became a more popular means of transportation. "The decision to heighten the tower no doubt saved the Terminal complex. "They created more than a 'Cathedral of Business': they created a visual symbol for the City of Cleveland — a land mark [sic] with a sense of identity answering to Cleveland's psychological needs and a square with an entirely new physiognomy and character" (http://www.csuohio.edu/CUT/gamut9.htm).

Facts

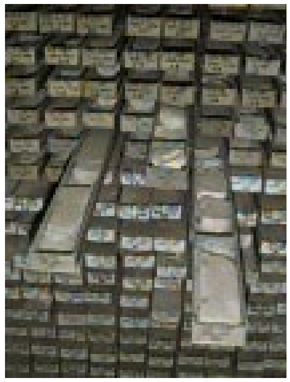
- Location: 50 Public Square, Cleveland.
- 52 floors.
- Dedicated in 1930.
- Function is office, hotel and retail.
- Second tallest building in the world when completed in 1930.
- The building is 708 feet tall.
- There is a 63-foot flagpole at the top, taking it to 771 feet.
- The steel-reinforced concrete supports for the Terminal Tower reach bedrock approximately 250 feet below the ground.
- Sixteen caissons support the building.
- More than 1,000 buildings were taken down to build the Tower Complex.
- Several streets were eliminated and others were built during the development of the complex.
- 2.5 million cubic yards of material was removed from the tower site.
- It was opened as the Cleveland Union Terminal and dedicated by the Van Sweringen brothers, Oris Paxton and Mantis James.
- The building management company was Forest City Enterprises.
- The architect was Graham, Anderson, Probst & White.
- The general contractor was John Gill & Sons
- The steel supplier was Carnegie Steel Company.

Sources:

Facts from **Skyscrapers.com** at http://www.skyscrapers.com/re/en/wm/bu/121783/.

Dirty Little Secrets: Foundations From the Past —a PBS 45 & 49 video production.

Core Samples



Core samples from Lamont-Doherty Earth Observatory (from the bottom of the ocean)

What are core samples?

Geology is the science that deals with the history of the earth and its life. Geologists study solid matter and geologic features on earth (and on the moon). Sometimes it's necessary to discover what is beneath the surface of the earth. Instead of digging vast pieces of land, geologists use drills to take samples to analyze the composition of the earth's interior. Core samples are used to determine where to place a building and how to support it, to find out if oil is part of a tract of land, to gather weather information and much more.

How are core samples used?

Some examples of the uses of core samples include the following:

- Core samples of oak trees taken in Illinois allow scientists to look at samples to determine the amount of rainfall, temperature, age of the tree and more. If you would like to examine the samples, go to http://www.bsu.edu/teachers/burris/iwonder/realities/activities/ctr.html.
- Samples from the moon were brought to Earth and studied. To get information on this project, go to http://www-curator.jsc.nasa.gov/curator/lunar/lunar.htm.
- Ocean drilling using ships to hold the drill presents new challenges to geologists. Want to find out more? Go to http://www.oceandrilling.org.

Core Samples from the Terminal Tower

In planning the Terminal Tower complex, soil engineers took core samples of the project area, the river area and the approaches to the building area. Each sample was recorded on a map showing location. Also shown was the subsoil condition. Basically what scientists found was ash and sand at the top level, gravel, clay and then shale. The shale is what the engineers were looking for. The shale was the bedrock that would give the tower a solid foundation.

For 40 or 50 years, the samples were kept in the Tower City Archives. Now they have been transferred to Cleveland State University. A team of geologists headed by Dr. Michael Tevesz of Cleveland State is now analyzing the core samples. They are separating, organizing, labeling, collecting data and graphing the results of their findings. It would be extremely difficult and expensive to break through concrete and asphalt to get these samples today.

The core samples give a history of the climate and the environment. Looking at the samples, scientists can look back in time and see if the area was wet or dry, warm or cold. They dig into the earth to find out what went on in the atmosphere. The sediments from the sample are compared to others. They are full of information about climate and environment. There is much yet to be revealed.

Core Samples

Tools used for drilling core samples

- **Coring Tool** — Different types to be used in different types of soils.
- **Completion Tool** — Used to isolate multiple zones in a borehole for independent zone investigation.
- **Downhole Tools** — Used to measure temperature.
- **Reentry Hardware** — Used to enter holes that are already drilled.
- **Water Line Tools** — Specialized tools are deployed by sandline cable to perform a wide range of tasks, including assistance in logging, core monitoring/orientation, and reentry.

Hotlist

For a picture of core sample storage go to http://rainbow.ldeo.columbia.edu/ees/glossary/core_samples.html.

Lesson Plans

Lake Erie Scavenger Hunt

Use the sites listed below to answer the scavenger hunt questions.

- **Geology of Lake Erie** http://www.avonhistory.org/hist/lakes1.htm
- **Lake Erie** http://www.pbs4549.org/SECRETS/DLSERIE.HTM
- **Natural Process in the Great Lakes Geology** http://www.epa.gov/glnpo/atlas/glat-ch2.html
- **River Valleys** http://earthsys.ag.ohio-state.edu/project/GLland/river_valley/river_valley

1. How did Lake Erie get its name? ____

2. Lake Erie is ________ miles long and ________ miles wide.

3. How many glaciers were responsible for the development of Lake Erie? ________

4. The theory that scientists use to explain the formation of Lake Erie is called the _______________ theory.

5. The shallowest lake of the Great Lakes is ____ .

6. Lake Erie drains into ____ .

7. The Great Lakes hold ______________________% of all of the fresh water on the surface of the Earth.

8. The Canadian Shield is made up of ____ rock.

9. What evidence of glaciation and geologic processes can be found on the beaches of Lake Erie? ______

____

____

____

10. When did Lake Erie form? ____

____

____

____

Lesson Plans

Lake Erie Scavenger Hunt Answer Key

Use the sites listed below to answer the scavenger hunt questions.

- **Geology of Lake Erie** http://www.avonhistory.org/hist/lakes1.htm
- **Lake Erie** http://www.pbs4549.org/SECRETS/DLSERIE.HTM
- **Natural Process in the Great Lakes Geology** http://www.epa.gov/glnpo/atlas/glat-ch2.html
- **River Valleys** http://earthsys.ag.ohio-state.edu/project/GLland/river_valley/river_valley

1. How did Lake Erie get its name? **From the Erie Indians who occupied the southern shore at one time.**

2. Lake Erie is **241** miles long and **57** miles wide.

3. How many glaciers were responsible for the development of Lake Erie?

There were 4: the Nebraskan, the Kansan, the Illinoian and the Wisconsin

4. The theory that scientists use to explain the formation of Lake Erie is called the **"lake effect"** theory.

5. The shallowest lake of the Great Lakes is **Lake Erie** .

6. Lake Erie drains into **the Niagra River** .

7. The Great Lakes hold **20** % of all of the fresh water on the surface of the Earth.

8. The Canadian Shield is made up of **hard, crystalli** rock.

9. What evidence of glaciation and geologic processes can be found on the beaches of Lake Erie?

Sediment deposits that are native to places away from Lake Erie.

10. When did Lake Erie form? **The foundation was laid 3 billion years ago. The glaciers lasted until about 22,000 years ago. and the lake formed about 10,000-15,000 years ago.**

Lesson Plans

Create Your Own Glaciers

Objective

Students will create a glacier and write about its effects.

The students will

- create a glacier using water and stones.
- pass the “glacier” over a piece of wood and record the shape of the scrapings.
- explain how scrapings and deposits made by glaciers could provide clues to the climate.

Procedure

1. Review with the students what they have learned about glaciers — how and why they move.
2. Ask students how they think scientists can tell if glaciers have moved over the land. Explain that rocks and gravel freeze. The weight of the glacier causes its bottom to be “plastic-like”; gravity pushes it down ridges and crevasses. What would happen to the land over which a glacier travels? What evidence would a glacier leave behind?
3. Tell the students they’re going to make a glacier. Divide the class into partners or groups of three.
4. Fill a paper cup with sharp pieces of gravel.
5. Cover the gravel with about an inch of water.
6. Tape plastic wrap tight over the top of the cup.
7. Flip the cup onto a paper plate, so that the plastic wrap is next to the plate.
8. Freeze overnight.
9. When the glaciers are frozen solid, have students peel off the plastic wrap and scrape them, gravel end down, over a smooth piece of wood to simulate the action of a glacier. Be sure to only scrape in one direction, because glaciers move in only one direction.
10. Have students observe the patterns the gravel has made on the wood. How would this compare to patterns made on the land by real glaciers?
11. Have students sketch their patterns and write a paragraph explaining what they can infer about the way real glaciers affect the landforms over which they move.
12. Discuss how patterns of glaciations provide clues to the climate in a particular area over time. For example, if evidence of glacial scraping is found in an area that is too warm for glaciers to exist, what can we infer about how the climate in that area has changed over a long period of time?

Lesson Plans

Create Your Own Glaciers

Material

- Plastic or paper cup
- Sharp pieces of gravel
- Water
- Plastic wrap
- Tape
- Paper plate
- Smooth piece of wood

Evaluation

3 points — sketches carefully and accurately drawn; paragraphs clear, complete and error-free

2 points — sketches adequate; paragraphs sufficiently clear, but with some errors

1 point — sketches adequate; paragraphs lacking in clarity with numerous errors

Adapted from a lesson by Frank Weisel, Earth Science Teacher, Tilden Middle School, Rockport, Maryland.

Lesson Plans

Cupcake Core Sampling

Level:

K-12

Objective:

Trying to "see" what is beneath the surface of the earth is one of the jobs of a geologist. Rather than digging up vast tracts of land to expose an oil field, or to find coal-bearing strata, core samples can be taken and analyzed to determine the likely composition of the earth's interior. In this activity. students model core sampling techniques to find out what sort of layers are in a cupcake.

Materials:

- Cupcake mix
- Plastic knives
- Foil baking cups
- Food coloring
- Drawing paper
- Toothpicks
- Frosting
- Plastic transparent straws

Activity:

Make cupcakes with at least three layers of colored batter. Provide each student with a cupcake, straw, toothpick and drawing paper. Foil baking cups and frosting will prevent the students from seeing the interior of the cupcakes in much the same way that a geologist can't see the interior of the earth.

Ask the students to fold a piece of drawing paper into four sections and in one of the sections draw what they think the inside of the cupcake would look like.

Ask the students how they might get more information about the cupcake without peeling the foil or cutting it open with a knife. Someone may suggest using the straw to take a core sample. If not, show them how to push the straw into the cupcake and pull out a sample (straws can be cut to a length slightly longer than the depth of the cupcake.) The students should make a second drawing of the cross section of their cupcake based on the information from three core samples.

Each new drawing should be carefully labeled and placed in a different section of the recording paper. Finally, the students should cut open the cupcakes with a knife to compare them to the drawings. Keep relating what the students are doing to what real-life geologists do. Nobody eats until the discussion is complete!

Adapted from materials provided by Women in Mining.

This lesson plan can be found at http://www.coaleducation.org/lessons/wim/4.htm

A similar lesson titled Layer Cake Geology, can be found at http://www.beloit.edu/~SEPM/Earth_Works/Layer_Cake_Geology.html.

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