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Thunder Bay Sinkholes 2008

What is a Karst?

Focus
Limestone landforms and aquifers

Grade Level
5-6 (Physical Science/Earth Science)

Focus Question
What processes create limestone landscapes and aquifers?

Learning Objectives
Students will be able to compare and contrast igneous, sedimentary, and metamorphic rocks, and name examples of each.

Students will be able to define karst landforms, describe typical features of these landforms, and explain processes that shape them.

Students will be able to define an aquifer, and discuss the relevance of karst landforms to aquifers.

Materials
For each student group:
- ❒ Copy of "Karst Inquiry Worksheet"
- ❒ Approximately 50 ml vinegar
- ❒ Small dish or watch glass
- ❒ Erlenmeyer or Florence flask, 250 - 500 ml, or narrow-neck bottle
- ❒ Cork or stopper to fit the flask or bottle
- ❒ One drinking straw for each student; mark one end with a black marker
- ❒ 100 ml of a slightly basic solution (add a pinch of sodium bicarbonate (baking soda) to tap water; see Learning Procedure, Step 1)
- ❒ About 5 drops phenol red indicator solution (Carolina Biological Supply Item No. 879875 or equivalent)
- ❒ (Optional) Samples of igneous, metamorphic, and sedimentary rocks

Audiovisual Materials
- ❒ None

Teaching Time
One or two 45-minute class periods

Seating Arrangement
Groups of three to four students

Maximum Number of Students
32

Key Words
Cold seeps
Sinkhole
Karst landform
Igneous
Metamorphic
Sedimentary

Background Information
In June, 2001, the Ocean Explorer Thunder Bay ECHO Expedition was searching for shipwrecks in the deep waters of the Thunder Bay National Marine Sanctuary and Underwater Preserve in Lake Huron. But the explorers discovered more than shipwrecks: dozens of underwater sinkholes in the limestone bedrock, some of which were

several hundred meters across and 20 meters deep. The following year, an expedition to survey the sinkholes found that some of them were releasing fluids that produced a visible cloudy layer above the lake bottom, and the lake floor near some of the sinkholes was covered by conspicuous green, purple, white, and brown mats.

Preliminary studies of the mats have found that where water is shallow (≤ 1.0 m) the mats are composed of green algae. In deeper (about 18 m) waters, mats are formed by filamentous purple cyanobacteria. Mats near the deepest (93 m) sinkholes are white or brown, but their composition is presently unknown. The appearance of mats near the deepest sinkholes is very similar to mats observed in the vicinity of cold seeps and hydrothermal vents in the deep ocean, which are often formed by chemosynthetic bacteria. These bacteria are able to obtain energy from inorganic chemicals, and are a food source for a variety of other organisms that inhabit cold seep and vent communities. Biological communities whose primary energy source comes from chemosynthesis are distinctly different from more familiar biological communities in shallow water and on land where photosynthetic organisms convert the energy of sunlight to food that can be used by other species. Hydrothermal vent and cold seep communities are home to many species of organisms that have not been found anywhere else on Earth, and the existence of chemosynthetic communities in the deep ocean is one of the major scientific discoveries of the last 100 years.

Scientists hypothesize that the source of the fluids venting from the Lake Huron sinkholes is the Silurian-Devonian aquifer beneath the lake's sediments. Aquifers are rocks and sediments that contain large amounts of water. Between 350 and 430 million years ago, during the Paleozoic era, shallow seas covered what is now the border between Canada and the United States between Minnesota and New York. Over thousands of years, sand, minerals, and sediments accumulated on the seafloor, and were gradually compressed to form sandstone, limestone and shale. About 1.8 million years ago, the Great Ice Age of the Pleistocene epoch began and continued until about 10,000 years ago. During this time, four major periods of glaciation occurred, separated by three interglacial periods. As the final glacial period came to a close, retreating glaciers along the U.S.-Canadian border revealed five huge lakes that we now know as the Laurentian Great Lakes. In the Great Lakes region, aquifers are found in deposits of sand and gravel left by glaciers, as well as in porous bedrocks (limestone and sandstone) that were formed much earlier in geologic time. Five major aquifers are recognized in this region: one near the land or lake floor surface (the surficial aquifer) and the others in deeper bedrock named for the geologic time periods when they were formed (the Cambrian-Ordovician, Silurian-Devonian, Mississippian, and Pennsylvanian aquifers). The bedrock that forms the Silurian-Devonian aquifer is primarily limestone and mineral formations from evaporating seawater. Both fresh and saline water are found in the Silurian-Devonian aquifer.

Sinkholes are common features where limestone is abundant, because limestone rocks are soluble in acid. Atmospheric carbon dioxide often dissolves in rainwater to form a weak acid (carbonic acid). Rainwater flowing over land surfaces may also pick up organic acids produced by decaying leaves and other once-living material. The resulting weak acid can slowly dissolve limestone rocks to form caves, springs, and sinkholes. Sinkholes on land are known recharge areas for the Silurian-Devonian aquifer (areas where water flows into the aquifer). But very little is known about the chemistry, geology, and biology of submerged sinkholes that may serve as vents for groundwater in the aquifer. Water samples collected near these sinkholes is very different from the surrounding lake, with much higher concentrations of sulfate, phosphorus, and particulate organic matter, as well as ten times more bacteria compared to nearby lake water. These observations suggest that submerged sinkholes may be biogeochemical "hot spots" inhabited by unusual and possibly unknown life forms. At the same time, water flow through submerged sinkholes depends upon recharge from land. This means that sinkhole ecosystems are likely to be very sensitive to changes in rainfall patterns that may accompany climate change, as well as human alterations of these landscapes surrounding recharge areas. These factors make understanding sensitive sinkhole ecosystems an urgent necessity.

In this lesson, students will investigate some characteristics of karst landforms and the processes that shape these landforms and lead to the formation of aquifers.

Learning Procedure

1. To prepare for this lesson:
   (a) Review introductory essays for the Thunder Bay Sinkholes 2008 Expedition at http://oceanexplorer.noaa.gov/explorations/08thunderbay/welcome.html.
   (b) Review procedures for "Karst Inquiry Worksheet" activities.
   (c) Prepare solutions for Inquiry Step 4: Add 4-5 drops phenol red indicator solution to about 100 ml tap water in the flask or bottle. If necessary, adjust the pH so that the solution is red by adding a small pinch of sodium bicarbonate (baking soda). Do not add too much, since if the solution is very basic a lot of blowing will be required to acidify the solution! Test the solution by blowing bubbles through a straw until the color changes to yellow. Then re-adjust the pH with sodium bicarbonate until the solution is red again. Stopper the flask or bottle.

2. Briefly introduce the Thunder Bay Sinkholes Expedition, highlighting the discovery of fluids emerging from sinkholes on the lake floor, and the variety of mats found in the vicinity of these sinkholes. Describe the major events involved in the formation of the Laurentian Great Lakes (shallow seas covering the area between 350 and 430 million years ago; sand, minerals, and sediments accumulating on the sea floor over thousands of years; compression of sediments to form sandstone, limestone and shale; the Great Ice Age with four major periods of glaciation, each leaving deposits of sand and gravel at the glaciers retreat). Do not discuss the formation of aquifers or karst landscapes at this point, since these are topics for student inquiry.

3. Ask students to define "karst landforms." If someone is able to offer an accurate definition, then say that their assignment is to explain how karst landforms are formed. If no one knows what a karst landform is, then say that their challenge is to discover what karst landforms are, and how they are formed.

   Provide each student group with supplies listed under "Materials," and a copy of the "Karst Inquiry Worksheet." Depending upon the maturity of students and their ability to follow instructions, you may want to do Steps 3 and 4 as group demonstrations. Steps 1, 2, 5 and 6 can be done in class if adequate research materials (or Internet access) are available, or can be assigned as homework.

   If rock samples are available, you may want to provide each group with an unidentified specimen and have them classify the specimen as igneous, metamorphic, or sedimentary as part of Step 1.

4. Lead a discussion of students' answers to inquiry topics. The following points should be included:
   (1) Igneous rocks are formed by the cooling and hardening of molten rock (magma). Common igneous rocks include
   Granite - coarse-grained, speckled appearance; composed primarily of feldspar

and quartz; formed from magma that cooled within the Earth's crust

Gabbro - coarse-grained, dark color; high content of iron and magnesium; formed from magma that cooled within the Earth's crust

Basalt - fine-grained rock, dark color; high content of iron and magnesium; formed by magma that cooled on the surface of the Earth or in the ocean

Rhyolite - fine-grained, light colored, composed primarily of feldspar and quartz; formed by magma that cooled on the surface of the Earth or in the ocean

Sedimentary rocks are produced by the accumulation and compression of sediments, and range from fine-grained particles to large irregular fragments such as pieces of shell. Fossils are contained in sedimentary rocks (heat and pressure that form igneous and metamorphic rocks destroy fossil remains). Common sedimentary rocks include:

Sandstone - formed from grains of sand produced by the weathering and breakdown of other rocks; may have a banded appearance if different layers of sediment have been compressed

Shale - formed from silt and clay; easily split along layers of sediment, resulting in flat pieces

Limestone - formed from calcium carbonate derived from the shells and skeletons of plants and animals; colors range from white to almost black

Chert - composed primarily of silicon dioxide; may be formed from silica-rich skeletons of organisms such as diatoms, radiolaria, and sponges, or by precipitation from silica-rich fluids leached out of magma; flint is a type of chert that has a black or dark gray color

Metamorphic rocks are formed when existing rocks are subjected to extreme heat and/or high pressure. Common metamorphic rocks include:

Slate - formed from shales subjected to high pressure

Schist - formed from slates subjected to high pressure

Gneiss - formed from schists subjected to high pressure; if gneiss is subjected to temperatures high enough to melt the rock, it becomes an igneous rock (granite); this is an example of the "rock cycle"

Marble - formed from limestone

(2) Limestone is a sedimentary rock formed from calcium carbonate.

(3) When limestone is exposed to vinegar, students should observe bubbles forming on the rock's surface. Students should infer that a chemical reaction is taking place between the vinegar and the limestone. They may also infer that the rock is dissolving. Depending upon students' familiarity with basic chemistry, you may want to discuss the reaction and identify the gas being produced as carbon dioxide.

$CaCO_3 + 2(CH_3COOH) > Ca(CH_2COOH)^2 + CO_2 + H_2O$

calcium carbonate + acetic acid (vinegar) > calcium acetate + carbon dioxide + water

(4) After blowing into the flask for a sufficient amount of time, students should observe the color of the solution change from red to yellow, and should infer that gases in their exhaled breaths have caused the solution to become acidic. Students should know that their exhaled breath contains more carbon dioxide than the air they inhale, and may infer that carbon dioxide has caused the solution to become more acidic.

(5) Based on their observations and inferences in Step 4, students should infer that carbon dioxide in the atmosphere may dissolve in rainwater, causing rainwater to become more acidic. Based on observations and inferences in Step 3, students should infer that acidic rainwater falling on limestone rocks may cause the rocks to dissolve.

(6) A "karst landform" is an area where limestone is the major rock underlying the land surface (that is, limestone is the "bedrock"), and the limestone has been partially dissolved to form caves and sinkholes.

(7) Aquifers are rocks and sediments that contain large amounts of water. Based on their observations and inferences, students should hypothesize that in areas where there is a lot of limestone rock, aquifers might be formed by acidic rainwater dissolving part of the rock.

The Bridge Connection

http://www2.vims.edu/bridge/ – Type "rain" into the search box on the left side of the page to locate links to lessons and activities dealing with acid rain.

The "Me" Connection

Have students investigate the primary sources for water supplied to their homes, and whether aquifers are involved.

Connections to Other Subjects

English/Language Arts, Earth Science

Assessment

Students' answers to inquiry topics provide a basis for assessment.

Extensions

1. Visit http://oceanexplorer.noaa.gov/explorations/08thunderbay/welcome.html to keep up to date with the latest Thunder Bay Sinkholes Expedition discoveries, and to find out what researchers are learning about these ecosystems.

2. Visit http://www.fi.edu/fellows/payton/rocks/lesson.htm for more lesson plan ideas about rocks.

Multimedia Learning Objects

http://www.learningdemo.com/noaa/ Click on the links to Lessons 3, 5, 6, 11, and 12 for interactive multimedia presentations and Learning Activities on Deep-Sea Corals, Chemosynthesis and Hydrothermal Vent Life, Deep-Sea Benthos, Energy from the Oceans, and Food, Water, and Medicine from the Sea.

Other Relevant Lesson Plans from NOAA's Ocean Exploration Program

Journey to the Unknown & Why Do We Explore

http://oceanexplorer.noaa.gov/explorations/02galapagos/background/education/media/gal_gr5_6_l1.pdf
(10 pages, 596k) (from the 2002 Galapagos Rift Expedition)

Focus: Ocean Exploration

In this activity, students will experience the excitement of discovery and problem-solving to learn about organisms that live in extreme environments in the deep ocean and come to understand the importance of ocean exploration.

AdVENTurous Findings on the Deep Sea Floor

http://oceanexplorer.noaa.gov/explorations/02galapagos/background/education/media/gal_gr5_6_l2.pdf
(5 pages, 536k) (from the 2002 Galapagos Rift Expedition)

Focus: Vent development along the Galapagos Rift (Earth Science)

In this activity, students will conduct investigations to observe the formation of precipitates, create a model of a developing hydrothermal vent, and generate comparisons between the created hydrothermal vent model and the actual hydrothermal vents developing along the Galapagos Rift.

Living With the Heat

http://oceanexplorer.noaa.gov/explorations/02fire/background/education/media/ring_living_heat_5_6.pdf
(6 pages, 88k) (from the 2002 Submarine Ring of Fire Expedition)

Focus: Hydrothermal vent ecology and transfer of energy among organisms that live near vents (Earth Science, Life Science)

In this activity, students will be able to describe how hydrothermal vents are formed and characterize the physical conditions at these sites, explain what chemosynthesis is and contrast this process with photosynthesis, identify autotrophic bacteria as the basis for food webs in hydrothermal vent communities, and describe common food pathways between organisms typically found in hydrothermal vent communities.

Let's Make a Tubeworm!

http://oceanexplorer.noaa.gov/explorations/02mexico/background/edu/media/gom_tube_gr56.pdf
(6 pages, 464k) (from the 2002 Gulf of Mexico Expedition)

Focus: Symbiotic relationships in cold-seep communities (Life Science)

In this activity, students will be able to describe the process of chemosynthesis in general terms, contrast chemosynthesis and photosynthesis, describe major features of cold seep communities, and list at least five organisms typical of these communities. Students will also be able to define symbiosis, describe two examples of symbiosis in cold seep communities, describe the anatomy of vestimentiferans, and explain how these organisms obtain their food.

And Now for Something Completely Different...

http://oceanexplorer.noaa.gov/explorations/05galapagos/background/edu/media/05galapagos_dfferent.pdf
(10 pages, 172k) (from the 2005 GalAPAGoS: Where Ridge Meets Hotspot Expedition)

Focus: Biological communities at hydrothermal vents (Life Science)

Students will identify and describe organisms typical of hydrothermal vent communities near the Galapagos Spreading Center, explain why hydrothermal vent communities tend to be short-lived, and identify and discuss lines of evidence which suggested the existence of hydrothermal vents before they were actually discovered.

What's That?

http://oceanexplorer.noaa.gov/explorations/05lostcity/background/edu/media/lostcity05_whatsthat.pdf
(7 pages, 356k) (from the The Lost City 2005 Expedition)

Focus - Investigating Lost City hydrothermal field ecosystems by remotely operated vehicles (Life Science/Physical Science)

In this activity, students will be able to describe a sampling strategy for investigating an unknown area, and will be able to explain why this strategy is appropriate for such an investigation; identify and discuss some of the limitations faced by scientists investigating unexplored areas of the deep ocean, and discuss how an autonomous underwater vehicle such as the Autonomous Benthic Explorer (ABE) can contribute to discoveries such as the Lost City Hydrothermal Field.

Chemists with No Backbones

http://oceanexplorer.noaa.gov/explorations/03bio/background/edu/media/Meds_ChemNoBackbones.pdf
(4 pages, 356k) (from the 2003 Medicines from the Deep Sea Expedition)

Focus: Benthic invertebrates that produce pharmacologically-active substances (Life Science)

Students will be able to identify at least three groups of benthic invertebrates that are known to produce pharmacologically-active compounds and will describe why pharmacologically-active compounds derived from benthic invertebrates may be important in treating human diseases. Students will also be able to infer why sessile marine invertebrates appear to be promising sources of new drugs.

Microfriends

http://oceanexplorer.noaa.gov/explorations/03bio/background/edu/media/Meds_microfriends.pdf
(6 pages, 420k) (from the 2003 Medicines from the Deep Sea Expedition)

Focus: Beneficial microorganisms (Life Science)

Students will be able to describe at least three ways in which microorganisms benefit people, describe aseptic procedures, and obtain and culture a bacterial sample on a nutrient medium.

Animals of the Fire Ice

http://oceanexplorer.noaa.gov/explorations/03windows/background/education/media/03win_fireice.pdf
(5 pages, 364k) (from the 2003 Windows to the Deep Expedition)

Focus: Methane hydrate ice worms and hydrate shrimp (Life Science)

In this activity, students will be able to define and describe methane hydrate ice worms and hydrate shrimp, infer how methane hydrate ice worms and hydrate shrimp obtain their food, and infer how methane hydrate ice worms and hydrate shrimp may interact with other species in the biological communities of which they are part.

Other Resources

The Web links below are provided for informational purposes only. Links outside of Ocean Explorer have been checked at the time of this page's publication, but the linking sites may become outdated or non-operational over time.

http://oceanexplorer.noaa.gov/explorations/08thunderbay/welcome.html – Follow the Thunder Bay Sinkholes 2008 Expedition daily as documentaries and discoveries are posted each day for your classroom use

http://celebrating200years.noaa.gov/edufun/book/welcome.html#book – A free printable book for home and school use introduced in 2004 to celebrate the 200th anniversary of NOAA; nearly 200 pages of lessons focussing on the exploration, understanding, and protection of Earth as a whole system

http://oceanexplorer.noaa.gov/projects/thunderbay01/thunderbay01.html – Web site for the 2001 Ocean Explorer Expedition to survey "Shipwreck Alley" in Thunder Bay, Lake Huron

http://gvsu.edu/wri/envbio/biddanda/sinkhole.htm – 1 minute ROV video clip of conspicuous white benthic mats interspersed with the brownish mats characterizing the lake floor in the vicinity of the sinkhole, and a dark cloudy nepheloid-like plume layer prevailing just over the site of submarine groundwater seepage

ftp://ftp.glerl.noaa.gov/eos/El_Cajon_Boils_Short.wmv – Underwater video of El Cajon "boils"

ftp://ftp.glerl.noaa.gov/eos/Purple_Mats_40_sec.wmv – Underwater video of the purple benthic mats from the Middle Island Sinkhole

Biddanda, B. A., D. F. Coleman, T. H. Johengen, S. A. Ruberg, G. A. Meadows, H. W. VanSumeren, R. R. Rediske, and S. T. Kendall. 2006. Exploration of a submerged sinkhole ecosystem in Lake Michigan. Ecosystems 9:828-842. Available online at http://www.glerl.noaa.gov/pubs/fulltext/2006/20060020.pdf

Ruberg, S.A., D.F. Coleman, T.H. Johengen, G.A. Meadows, H.W. VanSumeren, G.A. LANG, and B.A. Biddanda. 2005. Groundwater plume mapping in a submerged sinkhole in Lake Huron. Marine Technology Society Journal 39(2):65-69. Available online at http://www.glerl.noaa.gov/pubs/fulltext/2005/20050038.pdf

http://www.fi.edu/fellows/payton/rocks/lesson.htm – "Rock Hounds" lesson plans by Tammy Payton, from the Franklin Institute

http://edtech.kennesaw.edu/web/rocks.html – Links to information, activities, and lessons about rocks and minerals; from the Educational Technology Center at Kennesaw State University

http://www.sdnhm.org/exhibits/mystery/fg_timeline.html – Geologic timeline on the "Fossil Mysteries" Web page from the San Diego Natural History Museum

National Science Education Standards

Content Standard A: Science As Inquiry
- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

Content Standard B: Physical Science
- Properties and changes of properties in matter

Content Standard C: Life Science
- Structure and function in living systems
- Populations and ecosystems

Content Standard D: Earth and Space Science
- Structure of the Earth system
- Earth's history

Content Standard F: Science in Personal and Social Perspectives
- Populations, resources, and environments

Ocean Literacy Essential Principles and Fundamental Concepts

Essential Principle 2.
The ocean and life in the ocean shape the features of the Earth.

Fundamental Concept a. Many Earth materials and geochemical cycles originate in the ocean. Many of the sedimentary rocks now exposed on land were formed in the ocean. Ocean life laid down the vast volume of siliceous and carbonate rocks.

Fundamental Concept b. Sea level changes over time have expanded and contracted continental shelves, created and destroyed inland seas, and shaped the surface of land.

Essential Principle 4.
The ocean makes Earth habitable.

Fundamental Concept a. Most of the oxygen in the atmosphere originally came from the activities of photosynthetic organisms in the ocean.

Fundamental Concept b. The first life is thought to have started in the ocean. The earliest evidence of life is found in the ocean.

Essential Principle 5.
The ocean supports a great diversity of life and ecosystems.

Fundamental Concept b. Most life in the ocean exists as microbes. Microbes are the most important primary producers in the ocean. Not only are they the most abundant life form in the ocean, they have extremely fast growth rates and life cycles.

Fundamental Concept c. Some major groups are found exclusively in the ocean. The diversity of major groups of organisms is much greater in the ocean than on land.

Fundamental Concept d. Ocean biology provides many unique examples of life cycles, adaptations and important relationships among organisms (such as symbiosis, predator-prey dynamics and energy transfer) that do not occur on land.
Fundamental Concept e. The ocean is three-dimensional, offering vast living space and diverse habitats from the surface through the water column to the seafloor. Most of the living space on Earth is in the ocean.
Fundamental Concept f. Ocean habitats are defined by environmental factors. Due to interactions of abiotic factors such as salinity, temperature, oxygen, pH, light, nutrients, pressure, substrate and circulation, ocean life is not evenly distributed temporally or spatially, i.e., it is "patchy". Some regions of the ocean support more diverse and abundant life than anywhere on Earth, while much of the ocean is considered a desert.
Fundamental Concept g. There are deep ocean ecosystems that are independent of energy from sunlight and photosynthetic organisms. Hydrothermal vents, submarine hot springs, and methane cold seeps rely only on chemical energy and chemosynthetic organisms to support life.

Essential Principle 6.
The ocean and humans are inextricably interconnected.
Fundamental Concept a. The ocean affects every human life. It supplies freshwater (most rain comes from the ocean) and nearly all Earth's oxygen. It moderates the Earth's climate, influences our weather, and affects human health.

Essential Principle 7.
The ocean is largely unexplored.
Fundamental Concept a. The ocean is the last and largest unexplored place on Earth—less than 5% of it has been explored. This is the great frontier for the next generation's explorers and researchers, where they will find great opportunities for inquiry and investigation.
Fundamental Concept b. Understanding the ocean is more than a matter of curiosity. Exploration, inquiry and study are required to better understand ocean systems and processes.
Fundamental Concept d. New technologies, sensors and tools are expanding our ability to explore the ocean. Ocean scientists are relying more and more on satellites, drifters, buoys, subsea observatories and unmanned submersibles.
Fundamental Concept f. Ocean exploration is truly interdisciplinary. It requires close collaboration among biologists, chemists, climatologists, computer programmers, engineers, geologists, meteorologists, and physicists, and new ways of thinking.

Send Us Your Feedback

We value your feedback on this lesson.
Please send your comments to:
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Student Handout

Karst Inquiry Worksheet

1. Define the following types of rocks, and give an example of each:
   Igneous

   Sedimentary

   Metamorphic

2. What kind of rock is limestone?

3. Place a small piece of limestone in a shallow dish. Pour 50 ml of vinegar over the limestone. What do you observe, and what do you think is happening?

4. Obtain a flask containing water and a pH indicator. pH is a measure of whether a solution is acid, basic, or neutral. The solution in the flask is red when the solution is basic, but changes to yellow when the solution is acid.

   Take turns blowing into the flask through a straw. Be sure the black end of the straw is the end that goes into the flask.

   BE CAREFUL –
   - Do not blow so hard that the solution splatters out of the flask!
   - Do not inhale through the straw, and do not drink any of the solution!
   - Do not put the black end of the straw in your mouth!

   What change do you observe in the flask after your team has blown bubbles into the solution?

   Why do you think this happened?

   What gases are in the air from your lungs that you blew into the flask?

5. Air in the atmosphere contains about 3.8% carbon dioxide. What do you think happens when rain falls through the atmosphere?

   What do you think happens when rainwater falls on limestone rocks?

6. What is a “karst landform?”

7. What is an aquifer? How do you think aquifers might be formed in areas where there is a lot of limestone rock?