Hamilton Conservation Authority
Healthy Streams...Healthy Communities!

Eramosa Karst

Teacher Field Guide

A Grade 8 Teacher's Guide to Leading a Field Trip at the Eramosa Karst Conservation Area

Published by

Hamilton Conservation Authority
P.O. Box 81076
838 Mineral Springs Rd.
Ancaster, ON.
L9G 4X1
www.conservationhamilton.ca

Hamilton Conservation Authority
Healthy Streams...Healthy Communities!

Writing and Design

Alison Bekendam (Hamilton Conservation Authority)

Pictures and Diagrams

Chris Hamilton (Hamilton Conservation Authority)

Alison Bekendam (Hamilton Conservation Authority)

With Special Thanks To

Marcus Buck, B.Sc., P.Geo. Karst Solutions

Friends of the Eramosa Karst,

www. friendsoferamosakarst.org

Printed with the support of TD Friends of the Environment

TD Friends of the Environment Foundation

Introduction to the Guide

On this field trip, students will track water as it flows through the Karst, looking for clues of where water has been and where it is flowing now. They will make a hypothesis of what has happened to the water in a dry stream bed and collect evidence to support or reject their hypothesis.

This tour is divided into 13 stations, marked on your map. This guide contains directions to each station, an overview, information points, and activities for each station. Feel free to read information to students or re-phrase it in your own words. There is also an optional detour to Nexus Cave Entrance that will add about 20 minutes to your hike.

The USB drive that accompanies this guide includes pre-trip activities such as a “What is Karst” background slide show and modeling activities. Doing the Pre-Trip Activities before you go on this field trip will help your students understand more of what they see at the Eramosa Karst. There are also two role-playing activities to do after the field trip. They will help students review what they have learned and explore issues associated with water quality management further.

Objectives

Students will be able to

1. identify different karst features
2. form and test a hypothesis about what happened to the water at a dry creek bed
3. explain the challenges of protecting water quality in a karst aquifer

Materials

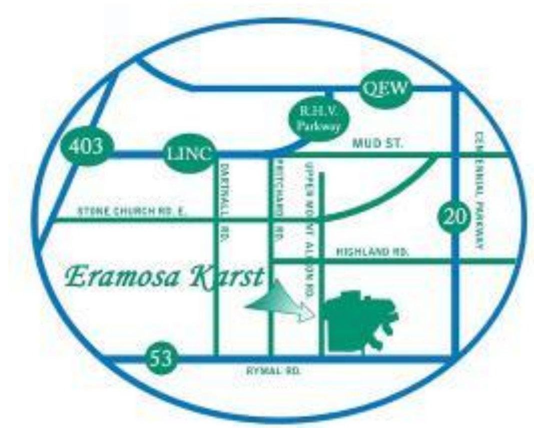
- Trail Map
- Worksheets (1 per student)
- Clip Boards (1 per student)
- Pencils (1 per student)
- Thermometers (1 per group)

Optional: pH Test Kit
Rubber Boots

Worksheets: Worksheets are found in the file Where’s the Water Worksheet on the USB Drive. The first 2 pages will help students keep track of information and the activities they have to participate in. The last page is optional and can be used at your discretion. Worksheets can also be modified to suit your class as needed.

Directions

How to get to the Eramosa Karst Conservation Area:



From the Lincoln Alexander Parkway, exit Stone Church Road East

Turn Left onto Stone Church Rd. E.

Turn Right onto Upper Mount Albion Road

The Eramosa Karst will be on your left hand side after the 4 way stop.

How to find your way around the Eramosa Karst:

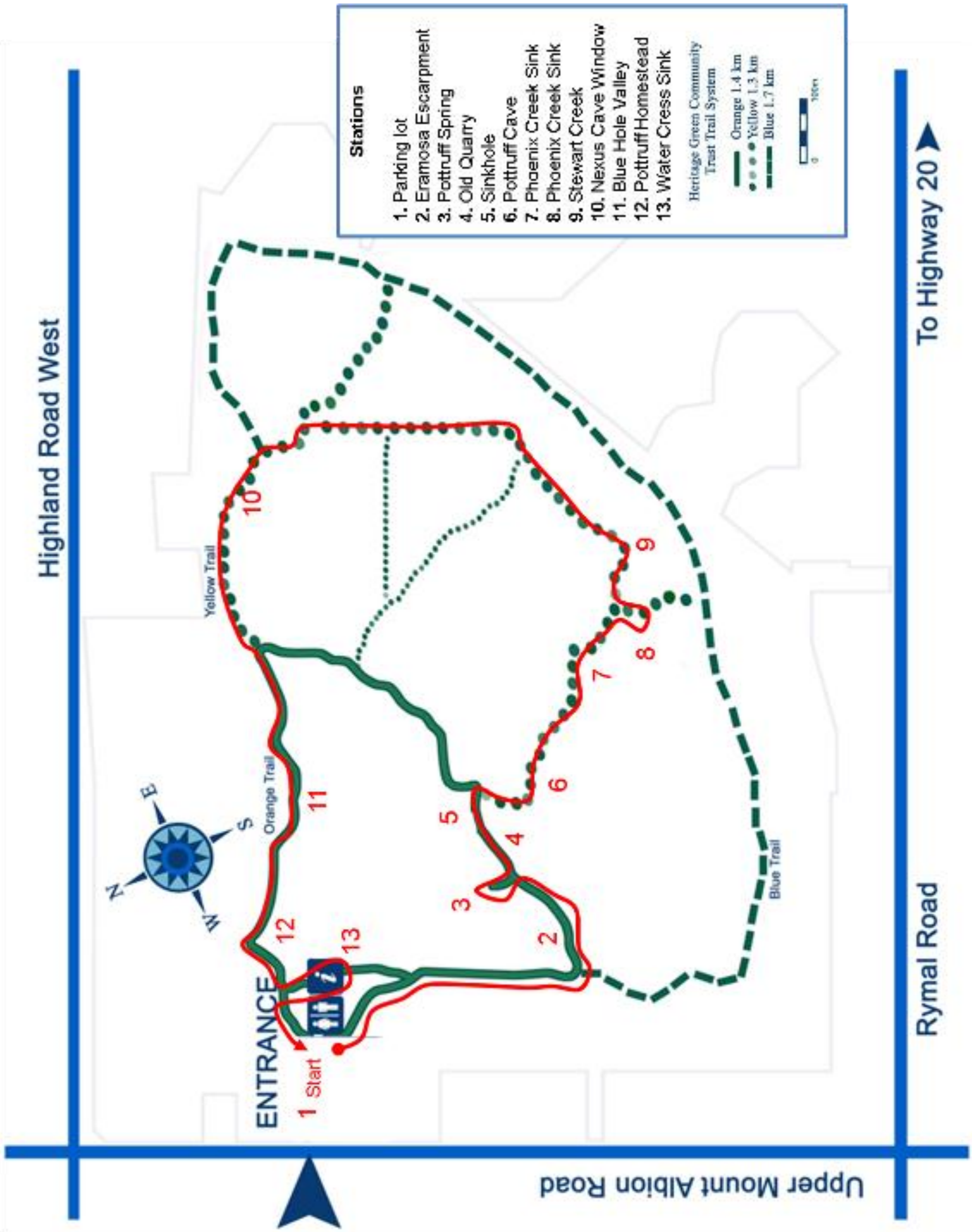
This trail guide contains directions to each station. At the end of each station description, you will find directions to the next station.

There is also a map making each station on the next page. You will start and finish at the Entrance, marked Station 1 Start.

Note: Unless otherwise indicated in this guide, continue straight on gravel paths, ignoring any unmarked forks or grass paths.

Station Overview

1. Parking lot
2. Eramosa Escarpment
3. Pottruff Spring
4. Old Quarry
5. Sinkhole
6. Pottruff Cave
7. Pottruff Blind Valley
8. Phenoix Creek Sink
9. Stewart Creek
10. Meadow
11. Nexus Cave Window
12. Blue Hole Spring
13. Watercress Sink


Highland Road West
Upper Mount Albion Road
Rymal Road
To Highway 20
ENTRANCE
1 Start
Yellow Trail
Orange Trail
Blue Trail
N
E
S
W
2
3
4
5
6
7
8
9
10
11
12
13
Stations
1. Parking lot
2. Eramosa Escarpment
3. Pottruff Spring
4. Old Quarry
5. Sinkhole
6. Pottruff Cave
7. Phoenix Creek Sink
8. Phoenix Creek Sink
9. Stewart Creek
10. Nexus Cave Window
11. Blue Hole Valley
12. Pottruff Homestead
13. Water Cress Sink
Heritage Green Community Trust Trail System
Orange 1.4 km
Yellow 1.3 km
Blue 1.7 km

Station 1: Information Centre at the Parking Lot

Overview: Burn off steam from travel, set the tone, explain work sheet, and introduce 'karst'.

Have students explore the information pavilion for a minute or two. They can look for fossils in the limestone seating area, read the sign posts, or examine the pavilion (which is designed to model a karst landscape).

Gather students together and draw their attention to their worksheet, making sure they understand they will be filling it out along the way.

Information Points:

The Eramosa Karst is a very special water system and has a unique role in this watershed.

A karst is a changing water system.

The water dissolves rocks to create underground channels and caves. These underground channels change the way water flows on the surface. In some areas streams just disappear, sinking underground.

In other areas, streams suddenly appear, flowing out of a rock face, or streaming after there has been a lot of rain.

This conservation area is filled with strangely behaving streams that aren't always where we might expect them to be. Today we are going to study these streams like scientists do, looking for clues that tell us where the water is and where it is going

Directions:
With your back to the parking lot, take the Orange Trail to the right.
Keep left to remain on the gravel Orange Trail, ignoring grass paths.
When you come to the signpost with 2 Orange arrows, keep to the right. You should still be walking away from the parking lot on the Orange Trail.

At the next fork, where the Orange and Blue Trails meet, keep left on the Orange Trail.

Station 2 is on your left in about 20 meters. Stop at a point where you can clearly see the ridge of rocks to the left. This is the Eramosa Escarpment and resembles a cliff about 2 meters high.

Time: 10 minutes

Station 2: Eramosa Escarpment

Overview: Water can dissolve some kinds of rock.

Information Points:

To the left of the trail you wi'll see large, cracked boulders and a very small cliff. This cliff is the Eramosa Escarpment.

These rocks are dolostone. They are very similar to limestone and most people can not tell the difference between the two kinds of rock. There are simple tests you can do to find out if a rock is limestone or dolostone (see pre-trip activities on the USB drive), but, for today, we'll just assume this rock is dolostone. Like limestone, dolostone is soluble in water.

Ask: What does soluble mean? (when something can be dissolved in water, like sugar in tea).

Notice how the rocks look like swiss cheese? This is evidence that the surfaces of these rocks have been dissolved by water. These bumps and holes are called 'karren' and are created when water pools in crevices and dissolves the surrounding rock.

Water also dissolves rocks under ground, creating caves. If you went down inside a cave, you'd see that the rocks there have the some of the same karren features.

Evidence of Water 1: Karren

Activity

Have students fill in the data for this station on their worksheet.

Optional: Have students find and draw an example of karren.

Directions:

Continue on the Orange Trail
Watch for the Pottruff Sping signpost on the left of the trail.
Keep left to take the side trail down the hill.
Pottruff Spring is at the bottom of the hill.

Time: 1 minute

Station 3: Pottruff Spring

The spring in summer: low flow

The spring in early spring: high flow

Overview: Water mixes with carbon dioxide to make carbonic acid; the acid responsible for dissolving carbonate rocks like limestone.

Information Points:

This stream has been flowing underground for several meters through the channels it dissolved in the bedrock. This spring is the point where it 'recharges' to the surface.

Do you think this water is pure or contaminated?
This isn't 'pure water'. Aside from the man-made chemicals it probably contains, it also has naturally occurring chemicals in it, like carbon dioxide.

Carbon Dioxide can be found in the air and in the soil. It is a natural gas created by humans, animals, and plants. When we breathe, we add carbon dioxide to the air. When plants decompose, they add carbon dioxide to soil.

When rain falls through the air or percolates through the soil, it picks up the carbon dioxide and becomes carbonic acid; the same acid you find in soda pop. This acidic water is what dissolves the dolostone and makes karst. Pure water could not do it.

Activity

In groups of 4-5, have students measure the water temperature. They will compare this temperature to water at a sink to learn what happens to water temperature underground.

- remind students to hold the thermometer at the top end only
- for the most accurate results, students should allow the thermometer to calibrate in the stream for a minute before reading the temperature
- each member of the group can take on a different role; eg. One holder, one counter, one reader, one recorder, etc

Optional Activity; in groups of 4-5, have students use litmus paper or a pH test kit to determine the pH of the water. They can then compare this to the pH of a sample of distilled water and a sample of soda water (carried with you). What pH do you expect? (they should expect to find an acidic pH).

Depending on the time of year and the amount of rain, the stream pH will be neutral or very slightly acidic. Results are difficult to predict for this activity and can be disappointing. It is recommended you test the pH before hand to see if the pH is noticeably acidic. If it isn't, consider skipping this activity.

Directions:

Return to the Orange Trail at the top of the hill.
Continue along the Orange Trail, going left towards the board walk.
Stop on the board walk bridge.

Time: 2 minutes

Station 4: Old Quarry

Overview: Water is flowing underground in a cave.

Information Points:

There are three things that seem a little bit odd about this area.   See if your students can identify any of them.

1. There is a bridge here although there is no water present.
2. There are also very few plants growing here. There are a few tress and some garlic mustard, but it does not look like the forest around it.
3. There is also visible bedrock here covered by little to no soil.

What force of nature could make these three things happen? Water, of course!
Water sometimes flows through here, washing away the soil and keeping plants from growing.

Where is the water now?
It is actually flowing in a cave underground, below our feet.   If it has rained a lot, the cave fills up to the brim and the extra water flows over the ground here. If you are here after there has been a large rainfalll, you might see the water flowing through the quarry.

Evidence of Water 2 & 3: Exposed Bedrock and Few Plants

Evidence of Water 4: Bridge

For Your Information:

This area is called The Old Quarry because people used to quarry rocks here. It was easy for them to chisel out pieces of overhanging rocks and let them fall to the ground. They then used these rocks to build houses and barns.

Directions:

Continue following the Orange Trail.
You will walk up a slight incline and around a bend.
When the ground levels out, watch for a large sinkhole to the right of the trail.
Stop beside the sinkhole.

Time: 2 minutes

Station 5: SInkhole

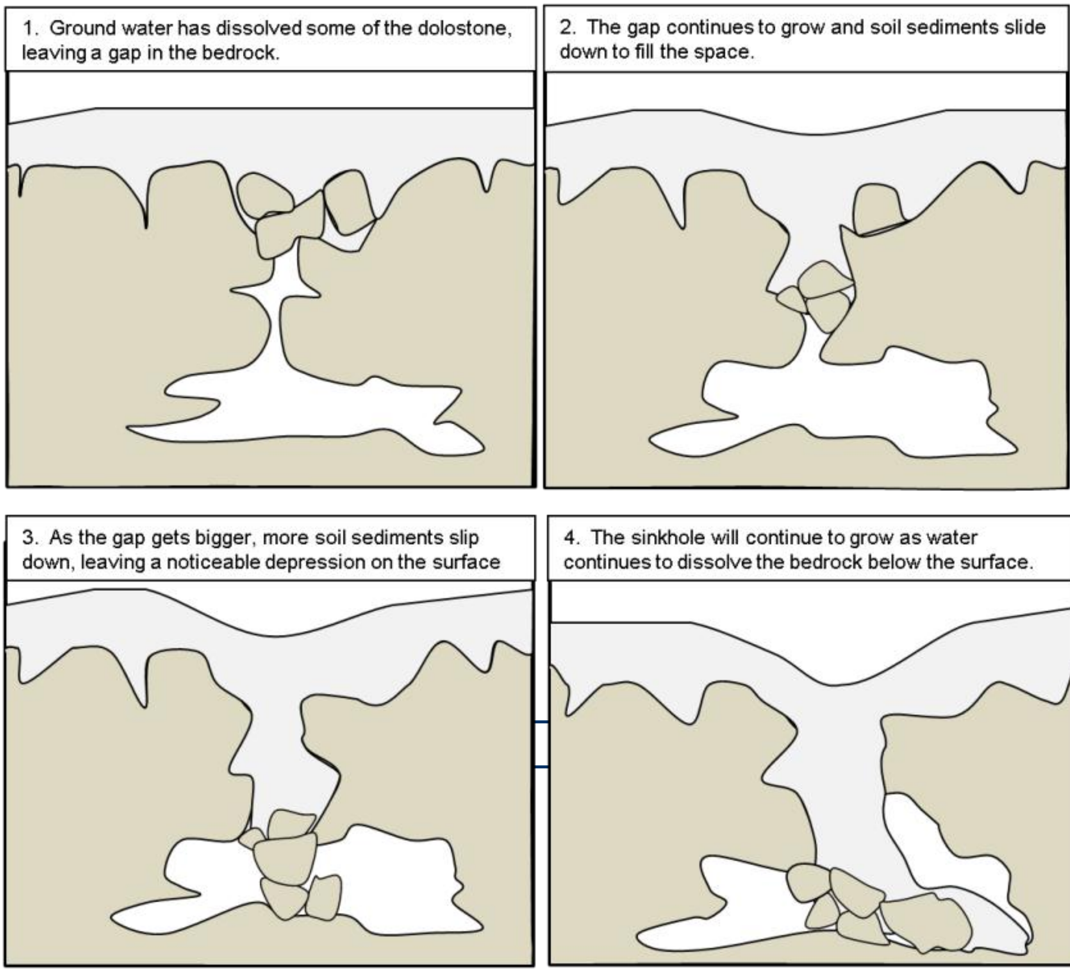
Overview: Sinkholes form when ground water dissolves the underground rock.

Information Points:

Sinkholes form when ground water dissolves the underground rock. The water left a gap in the bedrock. The soil on the surface slid down into the hole, creating this sinkhole. Imagine sand pouring through an hour glass. This is very similar to what happened here.

Sinkholes are also evidence for water. The water working underground dissolved bedrock, leaving this piece of evidence behind.

Evidence of Water 5: SInkholes



Directions:

At the sign post, follow the Yellow Trail to the right.
Stop at the Pottruff Cave sign post

Time: 2 minutes

Station 6: Pottruff Cave

Overview: This cave entrance was formed when the roof of the cave collapsed.

Information Points:

This cave is actually a collapse sinkhole. This cave used to be underground with water flowing through it. As the water dissolved more of the rock over the centuries, the ceiling eventually became too thin and collapsed, creating this opening.

Water still flows through the cave. In winter, it freezes.

There is a small underground cave here. It is very small and is usually filled with water so cavers have not been able to explore it completely.

After a large rain or snow melt, the underground channels can overflow with water. The excess water spills out and can flood the entire area.

The picture on the right was taken after an unusually large rainfall in Spring 2008. Notice the forked tree in the background. Imagine how high the water must have been to reach it.

Activity

Have students look for evidence of water here.
They should find the collapse sinkhole (the cave) and karren. Depending on recent rainfall, they may also see water in the bottom of the cave opening.

Have students think about what happened to the stream that used to flow through here. You can see the outline of the stream in the way the rocks have collapsed. The stream still flows through this area, but is deeper underground. Sometimes it does overflow and fill the channel.

Directions:

Continue along the Yellow Trail (heading towards the meadow)

When you see the sign post for Pottruff Blind Valley, continue around the corner. Watch for the very large, broken willow tree. (It looks like the Whomping Willow from Harry Potter). Stop Here.
Station 7 is the dry creek bed in the area behind the tree.

Have students explore the area, but use caution and watch out for fallen branches

Time: 5 minutes

Station 7: Pottruff Blind Valley

Overview: Having gained some familiarity with karst water systems, students will form a hypothesis about what happened to the water at a dry creek bed.

Activity

Have students explore the area then lead them in a discussion. Make sure you use caution when exploring this area; watch out for fallen branches and moving water.

Discussion: Is there flowing water here now?

If no: Was there ever water here? How do you know? (There is a dry creek bed here)

If yes: Is there always water here? How do you know? (This is difficult to guess. Have students think about if it's rained recently. There will only be water here if there has been a significant rainfall or snow melt recently)

Evidence of Water 6: Occasionally Dry Stream Bed

This is a blind valley. A blind valley is a place where water used to flow all the time but now flows only after a large rainfall. What might have happened to this stream? Why might a stream flow sometimes but not always?

We know a stream still flows through here because we saw the water at Pottruff Spring. So where is the water now?

In groups of 4-5, have students make a hypothesis about where the water is. What evidence do they have to support their hypothesis? They will check this hypothesis at the next station.

Directions:

Continue along the Yellow Trail
At the sign post, keep right and head towards the board walk.
Stop on the bridge.
Phoenix Creek Sink is to your right.

Time: 2 minutes

Station 8: Phoenix Creek Sink

Overview: Students collect evidence and determine if it supports their hypothesis from the previous station or not.

Information Points:

We can see the water sinking underground here. Scientists have tested the water and know that this is the same stream we saw spring up at Pottruff Spring.

It is difficult to guess the course the water took to get from here to there because it travels underground and we cannot see it flow.   But, we can look at the evidences of water on the surface and make hypotheses, like you did at Pottruff Blind Valley. We can then test them to see if we are correct.

One way scientists can tell if water has flown underground is by checking the water's temperature. In the summer, the spring water will be colder than water from a surface stream because the sun will not warm it up as it flows underground. In the winter, the spring water will be warmer because the cold air will not have chilled it, as it did the surface water.

Activity and Discussion: Making Observations

Have students explore the area and fill out the chart on their worksheet. If they made a hypothesis about the water at Pottruff Blind Valley, the activities here will help them determine if their hypothesis was correct.

Questions:

Is there water here?

If yes; Where is it going? (underground).

If no; When would there be water here? (When there has been recent rain or snow melt)

Is there dolostone here? (Yes; this proves there is a soluable rock here that can form karst)

Is there karren here? (Yes; this proves the water here is acidic enough to dissolve dolostone)

Take the temperature of water. Compare it to the Pottruff Spring temperature. Is the water warmer, colder, or the same? (In summer, the water should be warmer, in winter it should be cooler.)

Ask students if their hypothesis is correct based on this evidence. If they hypothesized that the water was flowing underground, beneath the blind valley, they're on the right track!

The evidence to support this is as follows:

1. We can see the water sink underground at an upstream point,
2. The dolostone has karren dissolved in it, so we know this water can dissolve rock and has the ability to create channels underground,
3. The temperature is different than at Pottruff spring, so the water has been heated or cooled as it flowed underground for a significant distance.

Directions:

Return to the sign post and continue along the Yellow Trail through the field.
Keep to the right and remain on the gravel Yellow Trail.
Follow the trail past the sign post for Stewart Creek Sink.
Stewart Creek runs to the right of the trail for several meters.
Stop at a place where you can see the creek through a break in the vegetation.

Time: 2 minutes

Station 9: Stewart Creek

Overview: This is the surface portion of the underground stream we have been following.

Information Points:

This is Stewart Creek before it sinks underground. Stewart Creek and Phoenix Creek both flow on the surface for 100s of meters before sinking underground.

Notice how the stream curves as it flows.
Streams only flow in straight lines if humans build structures that make them, like dams or concrete banks. Left on their own, streams curve and meander. These curves are important for healthy streams, allowing air to mix into the water. They also create habitats for plants, fish, and insects.

For Your Information: How scientists tracked the Karst's Underground Streams

The blue lines indicate the streams. The green line indicates the Karst boundary.

Stewart Creek and Phoenix Creek run on the surface before sinking underground.

Their sink points are very close to each other so scientists wanted to find out if these streams merge underground or flow in separate channels.

Looking at aerial photos, they guessed that the streams resurfaced at Pottruff Cave and Pottruff Spring but they did not know which stream went to which area. It was also possible that the streams merged underground and flowed together.


To find out where the streams resurfaced, scientists added a nontoxic yellow dye to Phoenix Creek and a nontoxic red dye to Steward Creek.


They then monitored the water at Pottruff Cave and Pottruff Spring to see which dye appeared where. They found traces of both dyes at both places. Based on this evidence, they inferred that the two streams merged underground and became one stream. They named the merged creek Pottruff Creek. You have already seen Pottruff Creek and will see it again.

Directions:

Continue along the Yellow Trail, heading towards the woodlot.
At the fork, keep left, staying on the Yellow Trail.
Make sure you stay on the gravel trail, ignoring any unmarked side trails.
Halfway along the trail, stop and observe the meadow to the right and left.

Time: 2 minutes

Station 10: Meadow

Overview: Fields and meadows play an important role in water systems.

Information Points:

Even though you don’t see any water here, this meadow is a very important part of the water system.

Meadows act as a kind of filter, regulating the movement of water into streams and aquifers. Rain water and storm run-off slowly percolate through the soil, eventually reaching a stream bed or aquifer.

The soil also helps to filter pollutants from the storm run-off water. Contaminants like litter, animal scat, and oil are trapped in the soil and kept from entering the water table.

Even though we don’t see any water here, this meadow is still very important to the water system.

Activity: Flowers and Seeds

In the spring, have your students look for 3 different kinds of meadow flower. Can they identify them?

In the winter and fall, have your students look for 3 different kinds of seed or seed pods.

Milkweed seedpods. These have already opened.

Queen Anne's Lace, Burdock, Thistle, and Golden Rod will also have seed pods this time of year.

Milkweed in bloom.

Golden Rod, purple Asters, and white Queen Anne's Lace should all be easy to find.

Directions:

Continue along the Yellow Trail and enter the woodlot.
Remain on the gravel trail as it passes through the woodlot, ignoring any unmarked side trails.
At the T intersection, keep left to stay on the Yellow Trail.
At the Stop at Nexus Cave Window

Time: 10 minutes

Station 11: Nexus Cave Window

Overview: This is a cave window that allows us to peak into the cave below. Water can easily enter the karst aquifer here. There is very little filtration in karst aquifers, making it easy for pollutants to travel through.

Information Points:

A karst is a kind of aquifer. An aquifer is an underground zone of rock or soil that contains and yields water. But karst is different from a typical aquifer.

Karst windows like this provide direct access to the underground water stores.

In a typical aquifer, the water is filtered through the soil before becoming part of the water table. This removes many of the contaminants from it.

Here, the water flows directly into the aquifer. If we dumped a bunch of garbage or chemicals into this hole, it would go straight into the water table.

Discussion

1. Would you drink this water? Why or why not?

Ask students to think about advertisements they have seen for bottled spring water. Any students who have a bottle with them can take a look at that. (Brands like Nestle Pure Life or Evian but not Dasani or Aquafina).

Those bottles usually say something about 'fresh spring water'. We usually think of 'fresh spring water' as being the purest and cleanest kind of water. But is the water from karst springs the same?

2. Would you drink the surface water from the creeks we saw on our tour? Why or why not?

3. How is that surface water connected to this spring water here?

(This is the exact same water)

In karst aquifers, 'spring water' is pretty much the same as surface water.
The water flows through caves the same way as water flows through a pipe: quickly, and with very little filtration. If you wouldn't drink the surface water in karsts , you shouldn't drink the spring water either.

Melted snow drips into Nexus Cave Window

Have your students look for evidence of water. Is there any flowing in the bottom of the cave? Any puddles? After a large rainfall, you might see water flowing into the cave window, like in the photo.

Note: From here, you can take an optional detour to Nexus Cave Entrance or continue on to Blue Hole Spring. The trip to Nexus Cave will add about 15 minutes to your tour. See details on the next page.

OPTIONAL DETOUR TO NEXUS CAVE ENTRANCE

This detour will add 15-20 minutes to your program.

Turn back and return along the Yellow Trail.
At the intersection, follow the Yellow Trail to the left.
Enter the Meadow and watch for the Nexus Cave Entrance signpost on the right.

.

Stop at Nexus Cave Entrance

Nexus Cave Entrance is an interesting area for students to explore. However, similar features are seen at Pottruff Cave and Nexus Cave Window, so if you are short on time or energy, it can be skipped.

Directions:
When finished, retrace your steps down the Yellow Trail back to Nexus Cave Window. Remember to keep to the right at the signposted intersection.

From Nexus Cave *Window*

Directions:

Continue on the Yellow Trail.
At the signpost for the Yellow and Blue Trails, keep left and follow the Yellow Trail.

At the signpost for the Yellow and Orange Trails, keep right and follow the Orange Trail.
Stop on the board walk at Blue Hole Spring.

Time: 10-15 minutes

While you're walking:

As this walk takes awhile, you can try the following activities to keep your students engaged.

Activity 1: There are many sinkholes in this area. Have students look for sinkholes and keep a tally of how many they see. At the end of the trip see who has counted the most.

Activity 2: Flood Game: Explain to the students that the path they are walking on is a dry creek bed that only floods when it rains and the underground caves overflow with water. When it floods, the only safe place to be is at the sides of the trail. Select a student or an adult to walk at the front of the group and be the Rain Forecaster. When the Rain Forecaster calls out "Flood", the rest of the students have to get off the trail before the forecaster turns around. Any student that gets caught on the trail gets washed away. Switch forecasters as feels appropriate.

Station 12: Blue Hole Spring

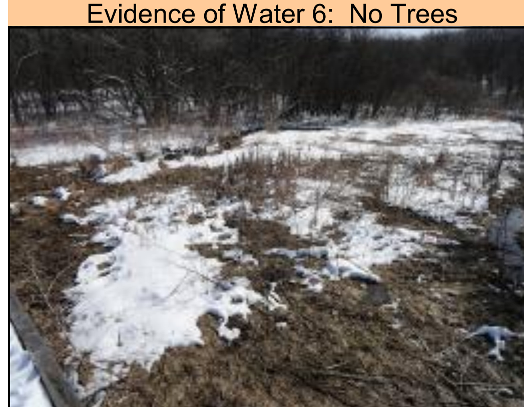
Overview: This area is a true Meadow. It will never regenerate into a forest as any tree seedlings that try to grow get washed out by occasional flooding. This is the last evidence of water in the karst.

Information Points:

There is an underground channel for water in this area. After a heavy rain, it overflows and the excess water springs up through Blue Hole Spring (to the south). The meadow can be completely flooded after a heavy rainfall.

That is where there are no trees here. Every time the meadow floods, the tree young saplings are washed away.

Evidence of Water 6: No Trees



Although trees struggle to grow here, a few shrubs, like Dogwood and Buckthorn do very well.

Try to find the large patch of dogwood. Its red branches stand out year round, making it easy to spot.

Buckthorn grows in a ring on the edge of the meadow. It can be identified by its black berries and thorny branches.

Directions:

Continue along the Orange Trail.
You will pass the East Mountain Trail Loop connection. Keep left to stay on the Orange Trail.
Pass the signpost for Pottruff Homestead (you can see the ruins to the left and right of the trail)
At the signpost for the Orange Trail, keep left and go towards Watercress Sink

Time: 10 minutes

Station 13: Watercress Sink

Watercress Sink as seen from the Orange Trail

Watercress Sink as seen from the Meadow (the other side of the Orange Trail).

Overview: Pottruff Creek at its last sinkpoint in the Eramosa Karst Conservation Area

Information Points:

This is Pottruff Creek. As described on page 20, it was formed underground when Phoenix Creek and Stewart Creek merged. We saw this creek at Phoenix Creek Sink, Stewart Creek, and at Pottruff Spring.   Watercress sink is the last sinkpoint in the Eramosa Karst.

This is the end of the surface stream in the Eramosa Karst, but it is not the end of the water system. In a few kilometers, it will spring up in the suburb you see to the North West. From there, it sinks down again, making its way down the Niagara Escapment and into Hamilton Harbour. Eventually this water will travel into Lake Ontario, out the St. Lawrence River and into the Atlantic Ocean.

Like every area of the Karst, Watercress Sink changes depending on the amount of rain that has fallen recently. The picture on the left was taken on a regular day.   The picture on the right was taken after an unusually large rainfall.

Summary

Take a moment to review the trip with the class.

-What was your favourite part of the Karst? What was your least favourite part?
-Why is it important to keep karst areas clean?
-How is the Karst part of Hamilton’s larger watershed?

Directions:

Trace your steps back to the Orange Trail.
At the signpost for the Orange Trail, keep left to return to the parking lot.
Watch for the bathroom and information centre.

Time: 5 minutes