



# **Ruby Falls Educational Resource Guide**

1-800-755-7105

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## Your Field Trip to Ruby Falls

|                      |   |
|----------------------|---|
| <b>Goal</b>          | Students will be provided with an inter-active tour in which there is an opportunity for questions and answers.   |
| <b>Instructional</b> | The students will be able to:   |
| <b>Objectives</b>    | <ol style="list-style-type: none"><li>1. Explain how caves are formed</li><li>2. Identify six types of formations found in limestone caves and explain how they are formed.</li><li>3. Name four minerals seen in the cave.</li><li>4. Explain the formation of sedimentary rock, the formation of mountains, and the role of water in these processes.</li><li>5. Develop an awareness of our environment.</li></ol>   |
| <b>Materials</b>     | Information on history and geology of Ruby Falls, vocabulary sheet, science experiments, and classroom worksheets.  |
| <b>Preparation</b>   | Teachers may use the information in the Resource Guide to prepare students for the visit. Teachers will want to explain to students that they will be able to observe many aspects of earth science first hand. Before visiting, teachers will want to point out the landforms and rock formations that students should look for while on the tour. It is also a good idea to remind students of the importance of listening and co-operating with the tour guides. |
| <b>Closure</b>       | After the field trip, teachers may want to use the enclosed materials to summarize what has been observed and to remind the students of the main points of the lesson. We have provided the enclosed thought questions to be a springboard for conversation with your students about their experience here at Ruby Falls.   |

### **A note to the teachers:**

We have attempted to include science terms that are common to the study of earth science and geology. The dialogue used is consistent with that used by most classroom textbooks. Depending on the age level of your students, you may want to adapt the presentation or the actual information itself to make it appropriate for your students.

## Educational Curriculum Standards

A field trip to Ruby Falls combined with a study of the provided Educational Guide meets the following Educational Curriculum Standards.

### National Standards

#### National Science Standards K-4

| Content Standard           |    | Topic   |
|----------------------------|----|---|
| A. Science as an Inquiry   | A1 | Abilities necessary to do scientific inquiry              |
| C. Life Science            | C3 | Develop an understanding of organisms and environments    |
|                            | C1 | Characteristics of organisms                              |
| D. Earth and Space Science | D1 | Develop an understanding of properties of earth materials |
|                            | D3 | Develop an understanding of changes to the earth and sky  |

#### National Science Standards 5-8

| Content Standard           |    | Topic  |
|----------------------------|----|--|
| A. Science as an Inquiry   | A1 | Abilities necessary to do scientific inquiry                       |
| C. Life Science            | C5 | Develop an understanding of diversity and adaptations of organisms |
| D. Earth and Space Science | D1 | Develop an understanding of the structure of the earth system      |
|                            | D2 | Develop an understanding of earth history                          |

## National Social Studies Standards

| Content Standard |          | Topic   |
|------------------|----------|---|
| Civics           | C.K-4.5  | Understand important responsibilities of Americans                              |
|                  | C.5-8.5  | Understand the roles of a citizen   |
| Geography        | G.K-12.3 | Understand the physical processes that shape the pattern of the Earth's surface |
|                  | G.K-12.5 | Understand how human actions modify the physical environment                    |

## National Language Arts Standards

| Content Standard         |                | Topic  |
|--------------------------|----------------|--|
| Reading for Perspective  | NL-ENG.K-12.1  | Students read a wide range of print and non-print texts to build an understanding of texts, of themselves, and of the cultures of the United States and the world; to acquire new information; to respond to the needs and demands of society and the workplace; and for personal fulfillment. Among of texts are fiction and nonfiction, classics, and contemporary |
| Applying Language Skills | NL-ENG.K-12.12 | Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information)  |

## Tennessee Standards

### Tennessee Science Curriculum Content Standards K-8

| Standard   | Learning Expectation       | Topic   |
|--|----------------------------|---|
| 9.0 Earth Features<br>(Earth Science)  | 1.9.1, 2.9.2, 3.9.1        | Identify the earth's major geological features  |
|  | 4.9.1, 5.9.1               | Recognize that the earth's geological features change   |
|  | 4.9.2, 5.9.2               | Know that the earth is composed of different layers   |
| 10.0 Earth Resources<br>(Earth Science)  | k.10.1, 2.10.1, 3.10.1     | Recognize that there are a variety of earth materials which have basic observable and measurable properties |
|  | 4.10.3, 5.10.3             | Realize the difference between renewable and non-renewable resources  |
| 5.0 Diversity of adaptations among living things<br>(Life Science)             | k.5.2, 1.5.2, 2.5.2, 3.5.2 | Recognize that living things have features that help them to survive in different environments              |
|  | 4.5.2, 5.5.2               | Determine that adaptations help organisms to survive in their environment                                   |
|  | 6.5.1                      | Understand how organisms are adapted for surviving in particular environments                               |
| 2.0 Interactions between living things and their environment<br>(Life Science) | k.2.2, 1.2.2, 2.2.2, 3.2.2 | Realize that organisms use their senses to interact with their environment                                  |
|  | 4.5.2, 5.5.2               | Determine that adaptations help organisms to survive in their environment                                   |
|  | 6.5.1                      | Understand how organisms are adapted for surviving in particular environments                               |

## Tennessee Science Curriculum Content Standards 9-12

| Standard   | Learning Expectation | Topic   |
|--|----------------------|---|
| 3.0 The Rock Cycle<br>(Geology)                                  | 3.1                  | Identify and differentiate between the three rock classes                                       |
|  | 3.2                  | Examine the processes responsible for forming the three rock classes                            |
| 5.0 Plate Tectonics<br>(Geology)                                 | 5.4                  | Describe the processes associated with volcanoes, earthquakes, and mountain building.           |
| 6.0 Personal and Civic Responsibility<br>(Environmental Science) | 6.1                  | Evaluate and articulate his/her own personal views concerning the environment                   |
|  | 6.2                  | Recognize his/her rights and responsibilities as a citizen in maintaining a healthy environment |

## Tennessee Social Studies Curriculum Content Standards

| Standard                  | Learning Expectation                            | Topic  |
|---------------------------|---|--|
| 3.0 Geography             | k.3.2, 1.3.2, 2.3.2, 3.3.2, 4.3.2, 5.3.2, 8.3.3 | Recognize the interaction between human and physical systems                                   |
|                           | 7.3.6, 9.3.6, 10.3.6, 11.3.6, 12.3.6            | Understand how physical processes shape the Earth's natural landscapes and affect environments |
|                           | 7.3.8, 8.3.8, 9.3.8, 10.3.8, 11.3.8, 12.3.8     | Understand how human activities impact and modify the physical environment                     |
| 4.0 Governance and Civics | k.4.3, 1.4.3, 2.4.3, 3.4.3, 4.4.3, 5.4.3, 8.4.5 | Understand the rights, responsibilities, and privileges of citizens                            |

## Tennessee Language Arts Curriculum Content Standards

| Standard          | Learning Expectation  | Topic   |
|-------------------|---|---|
| 1.0 Language Arts | K.0.1, 1.0.1, 2.0.1, 3.0.1, 4.0.1, 5.0.1, 6.0.2, 7.0.2, 8.0.2 | Develop the reading and listening skills necessary for word recognition, comprehension, interpretation, analysis, evaluation, and appreciation of print and non-print texts |

## Georgia Standards

### Georgia Science Performance Standards

| Concept          | Performance Standard | Topic   |
|------------------|----------------------|---|
| Earth Science    | SKE2                 | Students will describe the physical attributes of rocks and soils   |
|                  | S3E1                 | Students will investigate the physical attributes of rocks and soils  |
|                  | S5E1                 | Students will identify surface features of the earth caused by constructive and deconstructive forces   |
|                  | S6E5                 | Students will investigate the scientific view of how the earth's surface is formed  |
|                  | S6E3                 | Students will recognize the significant role of water in earth processes  |
| Physical Science | SKP1                 | Students will describe objects in terms of the materials they are made of and their physical properties   |
| Life Science     | S3L2                 | Students will recognize the effects of pollution and humans on the environment  |
|                  | SHS                  | Student will use process skills in laboratory or field investigations, including observation, classification, communication, and analyzing data |

### Georgia Social Studies Performance Standards

| Concept                            | Performance Standard | Topic  |
|------------------------------------|----------------------|--|
| Government and Civic Understanding | SSKCG1               | The student will demonstrate an understanding of good citizenship                            |
|                                    | SS5CG1.d             | Explain the responsibilities of a citizen  |
| Historical Understanding           | SS4H1.b              | Describe how the American Indians used the environment to obtain food, clothing, and shelter |



## Georgia Quality Core Curriculum Standards

| Concept                 | Topic                                   | Standard   |
|-------------------------|---|--|
| Inquiry                 | Reference Skills                        | Uses books and other media to obtain information related to science concepts   |
|                         | Activities/Tools                        | Actively engages in the learning process via hands-on/minds-on science activities and experiences  |
| Earth and Space Science | Earth Materials:<br>Physical Geology    | Classifies rocks according to the manner in which they are formed. Knows the primary groups of rocks (igneous, metamorphic and sedimentary) and knows that characteristics of rock types are a direct result of how they are formed. |
|                         | Earth Processes:<br>Physical Geology    | Recognizes changes that occur on the Earth's surface as a result of erosion and deposition. Describes examples of erosion and describe examples of deposition  |
|                         | Earth Processes:<br>Physical Geology    | Explores and discusses change in the Earth's surface due to plate tectonics  |
|                         | Geology                                 | Recognizes that constructive and destructive Earth forces (e.g., continental drift, earthquakes, volcanoes, plate tectonics, weathering, and erosion) change the Earth's surface.  |
|                         | Composition of the earth                | Describes the rock cycle and the importance of heat and pressure.  |
|                         | Formation of the earth's features       | Describes the theory of plate tectonics  |
|                         | Human Interactions with the Environment | Recognizes the effects human beings have on pollution and the environment.   |
| Life Science            | The Living World:<br>Animals            | Compares different kinds of animals and their protective adaptations. Identifies examples of animals with protective adaptations in color, physical structure and body markings and shadings,  |
|                         | Ecology/Interdependence of Life         | Describes the ability of organisms to change as necessity for species survival.  |
| Civics                  | Citizenship                             | Recognizes rights, duties and responsibilities of a U.S. citizen   |
| Language Arts           | Reading                                 | Demonstrates comprehension when reading  |
|                         | Reading                                 | Reads a variety of materials for information and pleasure.   |

## Alabama Standards

### Alabama Science Course of Study Content Standards

| Concept                 | Standard   |
|-------------------------|--|
| Earth and Space Science | Identify components of earth's surface including soil, rocks, and water  |
|                         | Identify evidence of erosion and weathering of rocks   |
|                         | Identify/describe geological features of earth   |
|                         | Classifying rocks and minerals by characteristics including streak, color, hardness, magnetism, luster, and texture  |
|                         | Describe factors that cause changes to earth's surface over time   |
| Geology                 | Explain natural phenomena that shape the surface of the earth including rock cycles, plate motions and interactions, erosion and deposition, volcanism, earthquakes, weathering and tide |
|                         | Identify natural surface openings including lava tubes, solution cavities, and caves   |

### Alabama Social Studies Course of Content Standards

| Concept           | Standard   |
|-------------------|--|
| Geography         | Identify human made and natural resources in the world   |
|                   | Describe physical characteristics including, landforms, bodies of water, soil, and vegetation of various places on Earth             |
|                   | Describe processes that shape the physical environment, including long range effects of extreme weather phenomena and human activity |
| Political Science | Identify ways to take personal action to protect the environment   |
|                   | Identify individual and civic responsibilities of citizens   |

## Geology of Ruby Falls

Lookout Mountain is a **landform** that is noted for its unusual geologic phenomena. One of its unique features is Ruby Falls, an underground waterfall, located deep inside Lookout Mountain. The fascinating story of the formation of Lookout Mountain and Ruby Falls is told by the rocks themselves through what scientists call the **Geologic Time Line**.

About 300 million years ago on an ancient seabed, skeletons of small creatures accumulated forming layers called **strata**. Successive layers of shale, sand and pebbly sand were deposited on top of the limy material and gradually these thick layers hardened to form a **sedimentary rock** called **limestone** (for more information on how rocks are formed see the rock cycle section). Scientists call this period in geologic time the **Carboniferous Period**. The Carboniferous Period was at the close of the **Paleozoic Era**, the oldest era in the **geologic time line** (before dinosaurs, mammals or birds had evolved).

It was during this period that the tectonic movements of the Earth's plates caused a series of powerful earthquakes. The plates pushing against each other buckled pushing rock upwards to form what is called a **folded mountain**. You know these folded mountains as the **Appalachian Mountain chain**. As the brittle layers of limestone and sandstone rose from the ocean floor, cracks or crevices opened. Scientists call these cracks or crevices **faults** or joints. Mountain ranges can form along normal faults. It was along a fault of this type that Ruby Falls was formed. Many of these fault joints can be seen along the ceiling and walls of Lookout Mountain Caverns.

Ruby Falls is located deep in the heart of Lookout Mountain. It is a limestone cave. The process that forms a limestone can be broken down into a few steps:

1. Carbon dioxide in the air is absorbed by rain water falling through it. The rain water also absorbs carbon dioxide that is in the soil after it hits the ground.
2. Water breaks carbon dioxide down into a very weak acid called carbonic acid.
3. The weak acid comes into contact with limestone rock when subterranean streams find their way through the cracks in the limestone rock that have been produced by tectonic forces.
4. The acid solutes (or eats away) the limestone (which is made of calcium carbonate or calcite) causing the cracks to become larger and caves and passages to form this process is called **chemical weathering**
5. **Physical weathering** by rocks, wind, water, and plants aids the formation of the cave by gradually eroding the limestone

Lookout Mountain Caverns actually consists of two caves. The lower cave is about 50 feet above the level of the Tennessee River and has no formations. The upper cave, containing Ruby Falls, lies directly above the original cave, but has no physical connection to it. The lower cave is permanently closed.

The formation of cave deposits (called **speleothems**) on the walls, floor and ceiling of the cave is a very slow process. The rate of growth varies from cave to cave; the average being one cubic inch every one hundred to one hundred fifty years. The largest formation at Ruby Falls, the *Leaning Tower*, is estimated to be between three and five million years old. The Ruby Falls cave is relatively dry which slows the formation's growth. The temperature in the Ruby Falls cave is about 60 degrees.

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There are many different types of formations to be found in the Ruby Falls cave. The most common are **stalactites**, **stalagmites**, and **columns**. These formations are caused by water containing minerals such as calcium carbonate dripping down from the ceiling. The rows of stalactites found on the ceiling are normally found along some joint or crevice in the limestone.

One of the best known rock formations is a **stalactite**. A stalactite forms when a drop of water falls from the ceiling leaving a tiny bit of calcite (or limestone) behind. The calcite builds up very slowly. At Ruby Falls you will see a group of stalactites called the *Crystal Chandelier*. All stalactites start out as **capillary tubes**. A capillary tube is a hollow stalactite. They are very thin and fragile. Capillary tubes are very common in the *Hall of Dreams*. When the hole on the end of a capillary tube is closed off, it becomes a stalactite.

Another type of stalactite you will see in the *Hall of Dreams* is a **helictite**. Helictites grow in any direction on the cave ceiling. Their twisted shape is attributed to air currents and the arrangement of the crystals of calcite.

**Stalagmites**, such as Ruby Falls' *Cactus and Candle*, are rock formations that grow up from the cave floor. A stalagmite is generally round and gets thinner at the top. Stalagmites are formed from dripping water like a stalactite only the drop of water falls to the ground and deposits the tiny bit of calcite. If a stalactite and stalagmite continue growing until they meet, they will make a **column**. The *Onyx Column* is a column at Ruby Falls that you will have a chance to examine.

**Curtains**, or **Drape formations**, have ripples and fold in them. These formations are formed as water works its way through the small crack in the ceiling and evaporates before it has a chance fall. The calcite builds up in a thin strip along the ceiling of the cave. The *Angel's Wing* and the *Arabian Drapery* are two examples you will see labeled at Ruby Falls.

There are several **flowstone** formations at Ruby Falls, but *Frozen Niagara Falls* is the best example. Flowstone is formed from flowing water instead of dripping water. The calcite is deposited in thin layers. These thin layers will first take the shape of the cave floor or bedrock underneath it. The flowstone builds up to become more rounded as it gets thicker.

The truly amazing feature of the Lookout Mountain caves is not the formations you see, but rather in the large vertical shaft at the end of the main passage that we refer to as the "falls room." A flowing underground stream falls from the very top of the shaft to form a 145 foot waterfall that collects in a pool on the cave floor. The volume of water in the waterfall depends on the amount of recent rainfall in the surrounding area. The water from Ruby Falls flows back through the cave and then down another waterfall (which is inaccessible) into the Tennessee River.

## Cave Life

Caves are home to some very unique animals that can not be found anywhere else on Earth. Cave animals have had to adapt to their environment. There is usually no light in a cave so many cave animals have lost the use of their eyes. Animals that live in caves may have a strong sense of touch or smell to help them find their way in the dark. Many have long antennae or extra sense organs for feeling their way through the cave. Ruby Falls is not home to any animals because the cave lacks a natural entrance to the outside world that would allow them to venture into its deep dark crevices, but many limestone caves are home to animals.

Bats are the best known cave animal. They are **nocturnal**, meaning they are active at night, come out after dark to hunt for their food. Bats use sound to find their way. They will send out a high-pitched squeak that is bounced off an object. The sounds are much too high pitched for human ears, but the bats can hear the echo and find their prey. It is called **echolocation**. After hunting for the evening, bats return to their roost. Bats sleep upside down with their wings wrapped around them to keep them from drying out.

Inside a cave you will find a variety of insects. One of the most common insects you will find is a cave cricket. Cave crickets live deep inside caves where no plants grow. They can survive so far from the outside world because they are **scavengers** eating plant and animal remains, or whatever comes drifting into the cave. Cave crickets have very long, sensitive **antennae**. The cricket's antennae are so long because they use them to find their way through the dark. They also use them to find food. A cave cricket's antenna is three times as long as the rest of its body. In addition to long antennae, the cave cricket also has very long legs that have hooks on the bottom to help it move through the cave. A cave cricket can use these hooks to climb the cave walls and even to hang upside down.

In the deep waters of some caves, you will find cave fish. Most of the cave fish are blind, but they very rarely bump into on another. Even if a cave fish had very good eye sight it would not do it any good in the blackness of the cave. The fish has nerves on the side of their bodies that allow them to sense vibrations and help them feel their way around. Cave fish also have a "hearing aid" on their backbones that make sound waves louder giving the fish excellent hearing. In the waters you may also find blind crayfish or salamanders. They have a lighter color to them because they have lost their **pigmentation** or skin color in the dark. Closer to the entrance of the cave you may find salamanders and frogs that are not blind. You can also find other kinds of fish.

There are some plants that grow in caves. Mosses and ferns grow in wet places near a cave's entrance. Further into the cave the air is chilly and the light is dim. Small green algae will grow on the rocks. Deep inside the cave there is no plant life because green plants need sunlight to carry out **photosynthesis** (the process that plants use to make food out of sunlight, air, and water.)

There are many other cave animals to learn about. One thing they will all have in common is that they have some kind of adaptation that makes living in a cave easier for them. If you ever visit another cave, you will need to be very cautious in case there are animals living there. The animals living in a cave are very fragile and easily harmed.

# History of Ruby Falls

## History

- The story begins with the original Lookout Mountain Cave. At one time, there was a natural entrance on the banks of the Tennessee River at the bottom of Lookout Mountain. The cave was used by:
  - American Indians
  - Outlaws as a hideout
  - A hospital during the Civil War
- The most significant piece of history in the Lookout Mountain Cave is Andrew Jackson's signature, the 7<sup>th</sup> president of the United States
- In 1905, the Southern Railway built a railroad tunnel through the edge of Lookout Mountain, which sealed off the natural entrance to the cave.

## Discovery

- Ruby Falls was discovered on accident in 1928 by cave explorer Leo Lambert when he was attempting to drill an elevator shaft to the old Lookout Mountain Cave
- Mr. Lambert decided to drill the elevator shaft to both Ruby Falls and the Lookout Mountain Cave and open them as tourist attractions.
- Ruby Falls opened to the public on June 16, 1930.

## How did Ruby Falls get its name?

- After discovering the 145-foot waterfall inside the Ruby Falls cave, Leo Lambert escorted his wife Ruby down to the falls and named it in her honor.

## Ruby Falls Castle

- This entrance building was modeled after a fifteenth century Irish castle and was built from the rocks taken out of the elevator shaft.
- 5 million pounds of limestone serve as the exterior of the entrance to Ruby Falls.
- From 1930-1935, both caves were open to the public, but Ruby Falls proved to be more popular. In 1935, the original Lookout Mountain Cave was closed to the public.
- Since 1929, millions of visitors have enjoyed the natural beauty and wonder of Ruby Falls
- Ruby Falls has been named to the National Register of Historic Places

## Environmental Education

The land all around us is changing, though it is not always easy to see. These changes are a natural result of the cycle of life, such as the process by which rocks change form. You can see this process in action in the Ruby Falls Cavern as you view the rock formations that have been shaped by water and time.

Sometimes human do things that cause these natural processes to happen to quickly or to take place where they should not. When this happens our **natural resources** are quickly destroyed. A natural resource is anything in nature that you can enjoy. Trees, water, and caves are all examples of natural resources. Ruby Falls is a natural resource that we can all enjoy.

Caves are very fragile ecosystems. They are home to some very unique animals. Some of the animals in a cave cannot survive in any other environment. Some of them are so small that you cannot see them, but scientists think they are very important because they are unique. The animals in some caves are found only in one individual cave which means that many cave animals are endangered species. The creatures that you find in a cave struggle to survive in their cold, dark home. Pollution to a cave's water can destroy the animals that call it home.

The formations in a cave take thousands of years to develop, but it only takes a minute for a careless person to break one. The damage done to a cave is permanent because a cave is a **non-renewable resource**. Non-renewable resources may take a very long time to replace or they may be irreplaceable. Ruby Falls is a non-renewable resource because if it were destroyed we could never recreate the beautiful formations inside.

We are all responsible for protecting all of our natural resources. Our government and some concerned people in our communities are now taking steps like recycling or creating protected areas such as National Parks. It is because of the conservation efforts that people can travel throughout the country and see natural formations, such as geysers, caves, and unusual plants and animals. We can all help to protect our caves by following using caution to avoid breaking or damaging the formations in caves. We can also pick up our litter and be careful not to pollute water that may find its way into the delicate cave system. The most important way to conserve our caves is education. If people are aware of the scientific value and natural beauty of the cave, they are less likely to damage the cave. Ruby Falls is proud to be on the National Register of Historic Places which means that Ruby Falls is unique and has an important place in the local history of Chattanooga and Lookout Mountain. We should all do our best to preserve it for future generations. A good conservation rule to remember for caves is "**Take nothing but pictures, leave nothing but footprints**".

## Cave Communication

- Calcite** - A mineral, calcium carbonate (CaCO<sub>3</sub>); the major component of limestone and nearly all formations.
- Capillary Tubes** - The first stage of growth of a stalactite, a narrow fragile formation that is hollow.
- Cave** - A natural underground chamber or series of chambers usually open to the surface.
- Chemical weathering** - A process which breaks down rocks by the action of chemicals.
- Column** - A pillar-like structure formed when a stalactite and a stalagmite have met and joined together.
- Curtain** - A thin, translucent sheet of calcite formed when water flows down the inclined ceiling of a cave. Syn. Drapery.
- Erosion** - the process by which weathered materials are carried away by wind, water, or glaciers.
- Fault** - A crack or parting in a rock, often occurring in sets or parallel groups.
- Flowstone** - A surface coating or a calcite layer that has been deposited by a descending film of mineral-charged cave water.
- Formation** - Any mineral deposit formed in a cave. Syn. Speleothem.
- Ground Water** - The part of subsurface water, which occupies cavities or pores in the rocks.
- Helictite** - A distorted and twisting stalactite that grows with a seeming disregard of the pull of gravity.
- Landform** - A feature of the earth's crust. Examples of landforms include mountains, valleys, plains, and plateaus.
- Limestone** - A sedimentary rock composed chiefly of the mineral calcite. Since it is easily dissolved by acidic ground water, most of the world's caves are formed in limestone.
- Natural Resource** - Any part of nature that humans can use or enjoy such as coal, oil, or natural areas such as parks.
- Non-renewable resource** - a natural resource which would be very difficult or impossible to replace because of its rarity or because it would take a very long time.



**Physical Weathering** - the process of breaking down rocks by a physical reaction such as wind, water, plants, or ice.

**Stalactite** - A formation that hangs down from the ceiling of a cave.

**Stalagmite** - A formation that grows upward from the floor of a cave.

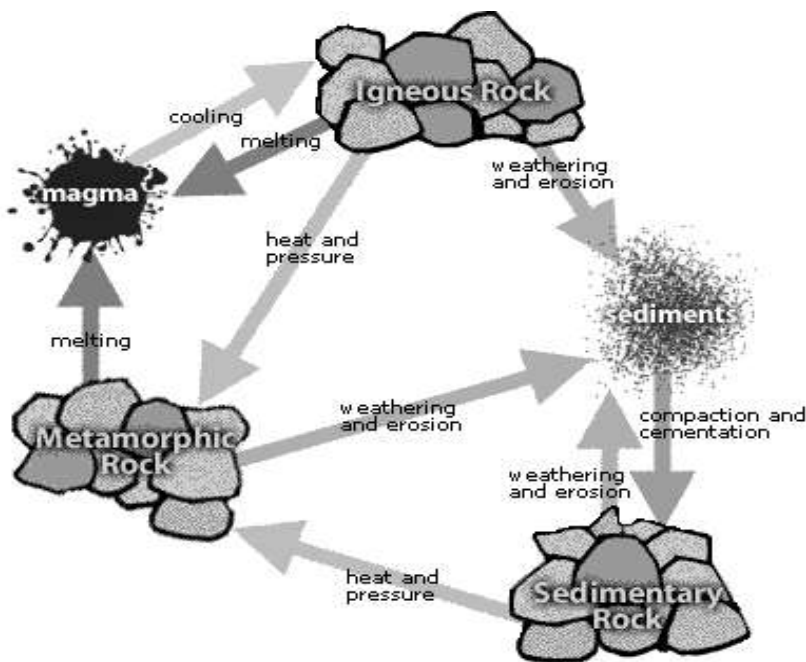
**Weathering** - The process of breaking down rock forms. Weathering may occur chemically or physically.

## Rock Cycle

**Igneous Rocks** are formed when molten magma from deep inside the Earth moves up towards the cooler regions. The magma cools and crystallizes to form the igneous rock. Sometimes the magma is erupted from a volcano as lava and cools on the Earth's surface. The rock could also cool inside the Earth.

**Sedimentary rocks** are formed when sediments are deposited in layers, or **strata**. These layers are pressed down until the particles become cemented together. **Limestone** rock is a type of sedimentary rock and contains the mineral **calcite**. Ruby Falls Cavern is made of limestone rock. Sedimentary rocks like limestone form layers that are visible and may contain fossils. While visiting Ruby Falls, you will be able to see layers in the rocks, but you will not see any fossils.

**Metamorphic rocks** are formed from sedimentary, igneous, or other metamorphic rocks. The rocks are formed by changes in pressure or changes in temperature.



The **rock cycle** is a continuous process that changes old rocks into new rocks. The chart shows how the cycle works. Rocks are added to the Earth's surface by tectonic movement and volcanic action. The rocks that are exposed to the surface are broken down into rock particles by weathering and erosion. The particles are transported by glaciers, rivers, and wind. They are deposited as sediment in lakes, deltas, deserts, and the ocean floor. Some of the sediments become **sedimentary rock**. The rock is then either pushed up to the surface or forced deep into the Earth. The rocks that are forced deep become **metamorphic rock**. The rock can then be pushed up to the surface or melted to form magma. The rock that becomes magma cools and solidifies to

become **igneous rock**. The rocks eventually work their way to the surface again and can be broken down again to begin the cycle.

## Thought Questions

**Teachers:** You will want to discuss these “Thought Questions” with your students after their trip to Ruby Falls. Hopefully, they will encourage verbal classroom participation. The answers here are some of the possible answers, but are not the only right answers.

### Why are there no animals in Ruby Falls?

*There are several reasons that animal life is limited in Ruby Falls. There are no large natural entrances to the caverns; there are limited food sources and little light.*

### What are some adaptations that animals may have as a result of living in a cave?

*Many cave animals are blind or do not even have eyes at all, and some are depigmented (colorless) from living in total or near total darkness. Bats are a good example of a cave creature that doesn't have very good sight. They use sonar to navigate in the darkness. Many cave creatures have a greater sense of touch or smell, which helps them live in the dark. Some creatures have longer appendages (arms and legs) for moving around the cave.*

### Why do you think there are no snakes in the caves at Ruby Falls?

*Snakes are reptiles, which are cold blooded. Because the cave is only about sixty degrees, it is not a suitable environment for snakes because they depend on the warmth of the sunlight and surroundings to stay warm. Also the natural opening of the cave is filled with water and any animal that is small enough to make it through the opening would have to survive the stream and waterfall.*

### What makes Ruby Falls a natural resource?

*A natural resource is anything from nature that humans can use and enjoy. Many people enjoy the tour and the beauty of the cave. Also the cave may have provided shelter and safety to our ancestors.*

### What do you think is the effect of humans on the caverns?

*Many formations have been destroyed or stolen. Sometimes people litter or mark on the cave. The basic pH of human skin might counteract the acid ( $\text{CaCO}_3$ ) that helps make formations, so if people touch the formations it may disrupt the formation's growth.*

## Quiz

1. Ruby Falls and Lookout Mountain are a part of which mountain chain?  
\_\_\_\_\_
2. What is the name of the process that helps form caves by breaking rocks apart with wind, water, or plants? \_\_\_\_\_
3. What is the name of the process that helps form caves by breaking rocks down by dissolving them? \_\_\_\_\_
4. a.) What kind of rock forms the cave? \_\_\_\_\_  
b.) What type (classification) is this rock? \_\_\_\_\_
5. What type of formation is formed when water drips down from the ceiling of the cave and leaves behind mineral deposits? \_\_\_\_\_
6. What type of formation is formed when water drips onto the floor of the cave and causes minerals to build up from the surface of the floor? \_\_\_\_\_
7. What formation occurs when the two formations growing from the ceiling and the floor of the cave meet? \_\_\_\_\_
8. What is the name of the mineral that crystallizes to form the cave formations?  
\_\_\_\_\_
9. What are the breaks in the surface of the earth along which mountains are formed?  
\_\_\_\_\_
10. During what era of the geologic time line were the mountain and caverns at Ruby Falls formed?  
(*Hint: this Period was called the Carboniferous Period*).  
\_\_\_\_\_

## Grow Your Own Rocks

### Gather these things:

- string (kite string works well)
- a pot (medium to large size)
- candy thermometer
- metal bowl or pan
- 2 cups water
- 5 cups sugar
- a spoon
- foil

Stretch the string across the top of the metal pan or bowl. You will need to let it droop into the liquid, but don't let it touch the bottom. Tape the ends to the outside of the pan or bowl to keep it from touching the bottom.

Put water and sugar in the pot and stir until the sugar dissolves. Place candy thermometer in water and cook until the liquid reaches 250 degrees. DO NOT stir after you have started cooking the liquid.

Carefully pour the VERY hot liquid into the pan or bowl that you have prepared with the string. Make sure that the string is at least  $\frac{3}{4}$  of an inch under the surface of the liquid. Cover the pan or bowl with foil and don't disturb it for a week. In 7 days, lift out the string and it will be covered with Rock Candy.

*Make sure to have an adult's help during the cooking and while working with the hot liquid!*

## Grow your own stalactite

Real Stalactites takes thousands of years to form, but you can make stalactites out of baking soda in just a few days.

### Gather these things:

- A piece of wool string
- Paper clips
- A spoon
- Two glass jars
- Baking soda
- A saucer

### Getting Started:

1. Put a few spoon full of baking soda into two jars of warm water. Stir and repeat until no more baking soda will dissolve.
2. Tie a paper clip to both ends of the string. Put one end in each jar of water and baking soda.
3. Wait for you stalactite to grow!

The solution will seep along the wool string and drip onto the saucer. A baking soda **stalactite** will form on the string. A baking soda **stalagmite** will form on the saucer below the stalactite.

## Ruby Falls Cave Terms Quiz

- 1) A Column is formed when:
  - a) limestone falls from the ceiling of the cave
  - b) rocks break down due to wind, water and ice
  - c) a stalagmite and a stalactite have met and join
  - d) water flows through a cave
  
- 2) A Curtain is a:
  - a) thin drapery formation with bands of different colors
  - b) thin translucent sheet of calcite formed by water
  - c) pillar like structure
  - d) none of the above
  
- 3) A crack or parting in a rock is called a:
  - a) Helictite
  - b) Cave
  - c) Formation
  - d) Fault
  
- 4) Chemical and Physical Weathering do what to rocks?
  - a) make them more valuable
  - b) break them down
  - c) make them more beautiful
  - d) make them grow larger
  
- 5) A cave is a natural opening beneath the Earth's surface large enough for you to fit what in?
  - a) your foot
  - b) an animal
  - c) a person
  - d) none of the above
  
- 6) What is a type of Stalactite?
  - a) a fault
  - b) a stalagmite
  - c) a helictite
  - d) a bacon rind
  
- 7) Physical Weathering is caused by:
  - a) wind
  - b) water
  - c) plants
  - d) all of the above
  
- 8) A part of nature that humans can enjoy such as coal, oil, or natural areas such as parks is:
  - a) a non renewable resource
  - b) a landform
  - c) a renewable resource
  - d) a natural resource

9) Wind, water and glaciers can make what happen?

- a) erosion
- b) formations
- c) faults
- d) none of the above

10) Ground water is located:

- a) on top of the ground
- b) under the ground
- c) both of the above
- d) neither of the above



## Ruby Falls Crossword Clues

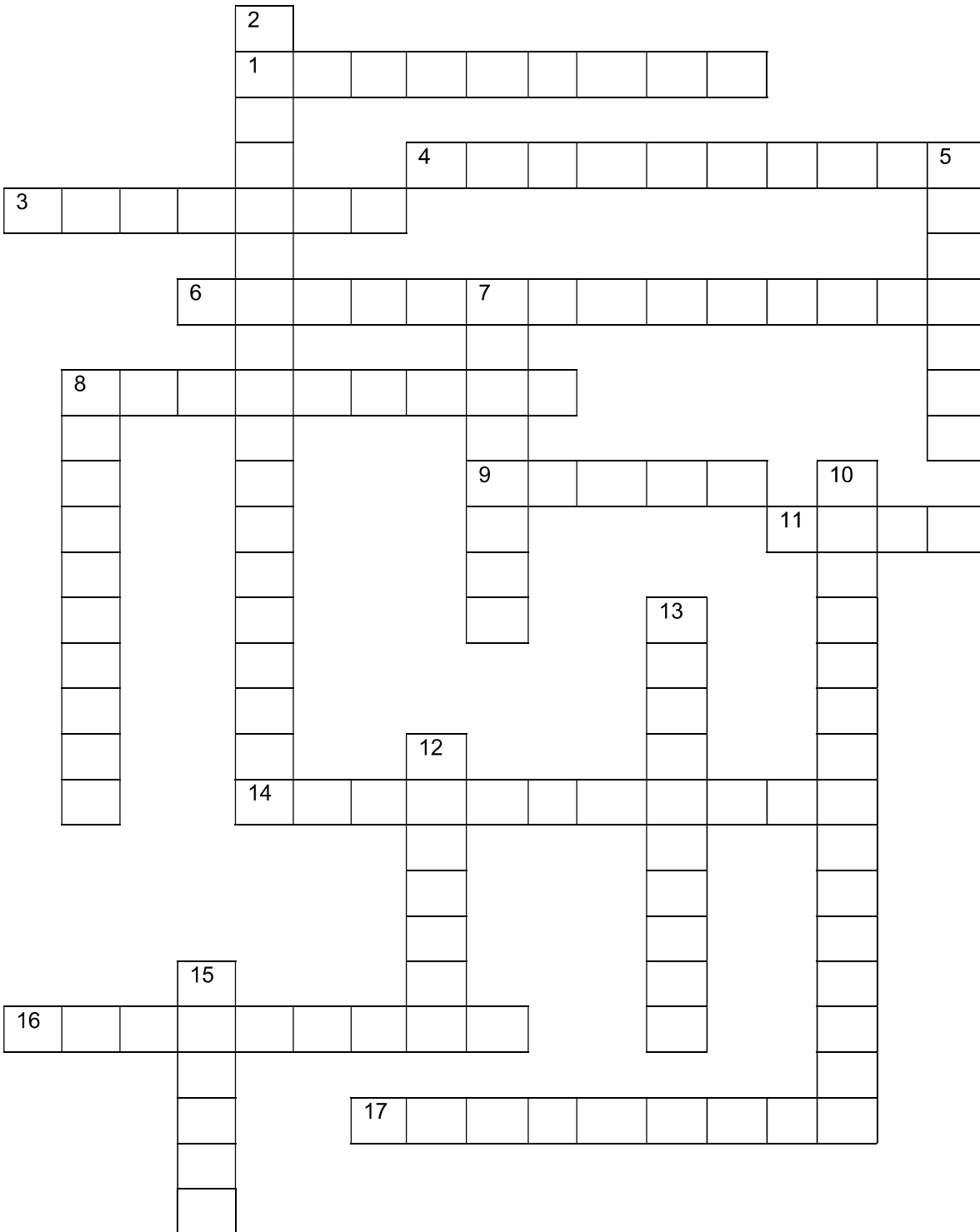
### Across:

- 1) A distorted, twisting stalactite that grows with a seeming disregard of the pull of gravity.
- 3) A mineral, calcium carbonate ( $\text{CaCO}_3$ ); the major component of limestone and nearly all formations.
- 4) A formation which hangs down from the ceiling of a cave
- 6) The first stage of growth of a stalactite, a narrow fragile formation that is hollow.
- 8) A surface coating or a calcite layer which has been deposited by a descending film of mineral charged cave water
- 9) A crack or parting in a rock, often occurring in sets or parallel groups.
- 11) A natural underground chamber usually open to the surface.
- 14) The part of subsurface water which occupies cavities or pores in the rocks.
- 16) A thin drapery formation with bands of different colors hanging from the roof of a cave like a large strip of bacon.

### Down:

- 2) A weathering process that breaks down rocks by chemical reactions
- 5) The process by which weathered materials are carried away by wind, water, or glaciers.
- 7) A feature of the earth's crust. Examples include mountains, valleys, plains, and plateaus.
- 8) Any mineral deposit formed in a cave
- 10) Any part of nature that humans can use or enjoy such as coal, oil, or areas such as parks.
- 12) A thin, translucent sheet of calcite formed when water flows down the inclined ceiling of a cave.
- 13) A formation which grows upward from the floor of a cave
- 15) A pillar-like structure formed when a stalactite and a stalagmite have met and joined together.
- 17) A sedimentary rock composed chiefly of the mineral calcite

# Ruby Falls Crossword Puzzle



## Teacher Answer Pages

### *Fill In the Blank Quiz Answers*

1. The Appalachian Mountain Chain
2. Physical Weathering
3. Chemical Weathering
4. Limestone, sedimentary rock
5. Stalactites
6. Stalagmites
7. Columns
8. Calcium Carbonate
9. Faults
10. The Paleozoic Era

### *Multiple Choice Quiz Answers*

1. C
2. B
3. D
4. B
5. C
6. C
7. D
8. D
9. A
10. B

