



Florida's aquifers: The treasure below

Background:

The main source of water for 90% of northeast and central Florida comes from underground aquifers. Aquifers can be thought of as vast underground, porous rocks that hold water and allow water to move through the holes within the rock. Aquifers can be composed of different types of earthen materials, such as sand, shell and limestone. Florida's geology influences the formation and operation of our aquifer and spring systems.

In some areas, water in an aquifer is confined or overlain by a thick layer of clay and then by more sandy soil extending up to the land's surface. Where water in an aquifer is confined, the water is under pressure. The pressure allows water to rise in a well above the top of the aquifer and, in some places, water rises above the land's surface without a pump, creating an artesian free-flowing well.

The water stored in the aquifer is replenished, or recharged, by rainfall. On average, Florida receives 51 inches of rain each year. However, not all of the rain reaches the aquifer. About 38 inches evaporates or runs off the land into surface waters, like lakes, rivers and streams, before it has a chance to soak into the ground. This leaves, on average, 13 inches annually to recharge the aquifer in limited areas.

Scientists have determined — or “age dated” — the water in the Floridan aquifer as being between 17 to 26,000 years old. The age of the water varies because of the time it takes water to seep vertically and move horizontally through different types of soil. Sandy soils are most suited to allowing water to seep into the ground, while soils such as clay are more difficult to penetrate.

In addition to supplying drinking water to many of the millions of Florida residents and the state's visitors, recreational opportunities are found in water that escapes from aquifers, known as springs. Springs are found in many places, including the Atlantic Ocean, lakes and rivers.



Find out more about the St. Johns River Water Management District and Florida's aquifer systems at www.sjrwmd.com/aquifer.

VIDEO LESSON PLAN • Florida's aquifers: The treasure below

Vocabulary words:

aquifer	confining layer
erosion	limestone
plate tectonics	recharge
horizontal salt water intrusion	vertical salt water intrusion

Pre-assessment: (5 minutes)

Have students answer these questions:

- Why is it important for Florida residents to understand how the natural aquifer systems work?
- How could Florida residents disturb the equilibrium of this natural system?

Engage: (5 minutes)

Tell the students the video is about the natural systems of Earth, how Florida was formed, and the present natural systems of Florida. The video will show how these systems operate and how they can be disturbed. Ask the students the following questions:

- Where does your drinking water come from?
- Have you had any experiences with the aquifer? (Times that they have swam in the springs they have had experiences with the aquifer.)

Explore/Explain: (20 minutes)

Pass out copies of the student page. Watch the video “*Florida’s Aquifers: The Treasure Below*” and instruct students to write down the answers to the questions. Warn them that the video goes fast so they need to pay close attention. Pause the video player for a short time every few minutes to allow students to write. Instruct them to draw and label the layers of the aquifer and to write down the answers to the questions on the student page.

Next Generation Sunshine State Standards

SC.6.E.6.1: Describe and give examples of ways in which Earth’s surface is built up and torn down by physical and chemical weathering, erosion, and deposition.

SC.7.E.6.2: Identify the patterns within the rock cycle and relate them to surface events (weathering and erosion) and subsurface events (plate tectonics and mountain building).

SC.7.E.6.4: Explain and give examples of how physical evidence supports scientific theories that Earth has evolved over geologic time due to natural processes.

SC.7.E.6.5: Explore the scientific theory of plate tectonics by describing how the movement of Earth’s crustal plates causes both slow and rapid changes in Earth’s surface, including volcanic eruptions, earthquakes, and mountain building.

SC.912.E6.2: Connect surface features to surface processes that are responsible for their formation.

SC.912.E.6.3: Analyze the scientific theory of plate tectonics and identify major processes and features as a result of moving plates.

SC.912. E6.4: Analyze how specific geologic processes and features are expressed in Florida and elsewhere.

SC912. L.17.16: Discuss the large-scale environmental impacts resulting from human activity, including waste spills, oil spills, runoff, greenhouse gases, ozone depletion, and surface and groundwater pollution.

SC912. L.17.18: Describe how human population size and resource use relate to environmental quality.

VIDEO LESSON PLAN • Florida's aquifers: The treasure below

Evaluate: (5–10 minutes)

After viewing the video, discuss with the students what they wrote for each question and clarify the answers. The teacher may elect to show the video again and stop it at each question and answer.

Answers to questions:

Directions: Answers to the questions about the history and geology of Florida using the information provided in the video.

1. What is an aquifer, and why is it important for Florida residents to understand how aquifers function?

An aquifer is a layer or layers of rock, shell, or sand in any combination that holds water. The aquifer systems are important because they are the main source of drinking water in Florida.

2. What happens to the Floridan aquifer as it flows south?

It gets too salty for most uses by the time it reaches southern Florida.

3. What is the tectonic theory of continental drift?

The tectonic plates, the major continents, and the surrounding seafloors of the earth move at a very slow rate and may, over millions of years, collide or move apart.

4. How was Florida affected as the continental plates drifted apart?

Geologists theorize that the Florida peninsula was originally attached to the African plate and became attached to the North American plate during an ancient collision of the tectonic plates over 300 million years ago.

5. How was the limestone that underlies Florida formed? How long did it take?

A sedimentary rock called limestone was formed over millions of years by the bodies of thousands of sea creatures, particularly those with shells, falling to the bottom of the ocean and then being compressed by many layers of sediment.

6. What was the role of the Appalachian Mountains in forming the geology of the peninsula of Florida?

Approximately 30 million years ago, the Appalachian Mountains began to grow or be pushed upward, causing erosion. The material eroded, moved downhill by gravity, and redeposited over the submerged limestone base of the peninsula of Florida. These fine particles of eroded materials or clay then formed a confining layer over the limestone that now keeps water in the aquifer.

7. Although Florida was never covered by ice, the global ice ages did have an effect on Florida's geology. How did the growing and receding of glacial ice during the ice ages affect Florida's shorelines?

The growing and receding of the glaciers during the ice ages changed Florida's shorelines, because during warmer periods, the ocean rose and eroded Florida's shorelines. During the cooler periods, the ocean receded and eroded other shorelines. If you look at the cross-sectional diagram showing Orlando, Tampa, and Daytona Beach, you can see Florida's ancient shorelines.

8. What role did erosion take in forming the caves of Florida's spring systems?

Over time, the water within the limestone layer traveled or moved over the limestone, eroding a system of holes and creating caves that filled with freshwater. These systems of holes and caves form our aquifer and spring systems.

VIDEO LESSON PLAN • Florida's aquifers: The treasure below

9. What determines whether rainwater will drain into a body of water, such as a lake or the ocean, or soak down into the aquifer?
- Two factors affect where the rainwater will drain. One is gravity; water always flows downhill. The second is that rainwater can only move into the aquifer in areas where there is little or no confining layer.*
10. What is the name for the areas where water can soak down into the aquifer and refill it?
- These areas with limited or no confining layers are called aquifer recharge areas.*
11. Why is salt water naturally found below freshwater in the aquifer?
- The ocean covered Florida many times throughout history. Salt water was trapped in Florida's rock formations, so it is found naturally in many areas. Salt water is denser than freshwater so the two remain separate as long as the aquifer is undisturbed.*
12. What is saltwater intrusion?
- When too much freshwater is withdrawn from the aquifer, salt water can be drawn into the aquifer from the trapped salt water, the ocean, or Gulf of Mexico, making the water undrinkable. This process is called saltwater intrusion.*
13. How is saltwater intrusion related to population growth and development?
- Saltwater intrusion increases when groundwater is consumed faster than it is replaced through the recharging process. In other words, the balance of the aquifer system is disturbed. For example, as many areas of Florida continue to develop and the population increases, so does the demand for freshwater, thus making saltwater intrusion more likely.*
14. What is one of the most important ways to protect our water supply from saltwater intrusion?
- One of the best ways to protect our drinking water is to conserve water.*

FLORIDA'S AQUIFERS: The treasure below

Name: _____

Date: _____

Directions: Answer the following questions using information you learned watching the video.

1. What is an aquifer, and why is it important for residents of Florida to understand how aquifers work?

2. What happens to the Floridan aquifer as it flows south?

3. What is the tectonic theory of continental drift?

4. How was Florida affected as the continental plates drifted apart?

5. How was the limestone that underlies Florida formed? How long did it take?

FLORIDA'S AQUIFERS: The treasure below

6. What was the role of the Appalachian Mountains in forming the geology of the peninsula of Florida?

7. Although Florida was never covered by ice, the global ice ages did have an effect on Florida's geology. How did the growing and receding of glacial ice during the ice ages affect Florida's shorelines?

8. What role did erosion take in forming the caves of Florida's spring systems?

9. What determines whether rainwater will drain into a body of water, such as a lake or the ocean, or soak down into the aquifer?

What is the name for the areas where water can soak down into the aquifer and refill it?

10. Why is salt water naturally found below freshwater in the aquifer?

FLORIDA'S AQUIFERS: The treasure below

11. What is saltwater intrusion?

12. How is saltwater intrusion related to population growth and development?

13. What is one of the most important ways to protect our water supply from saltwater intrusion?
