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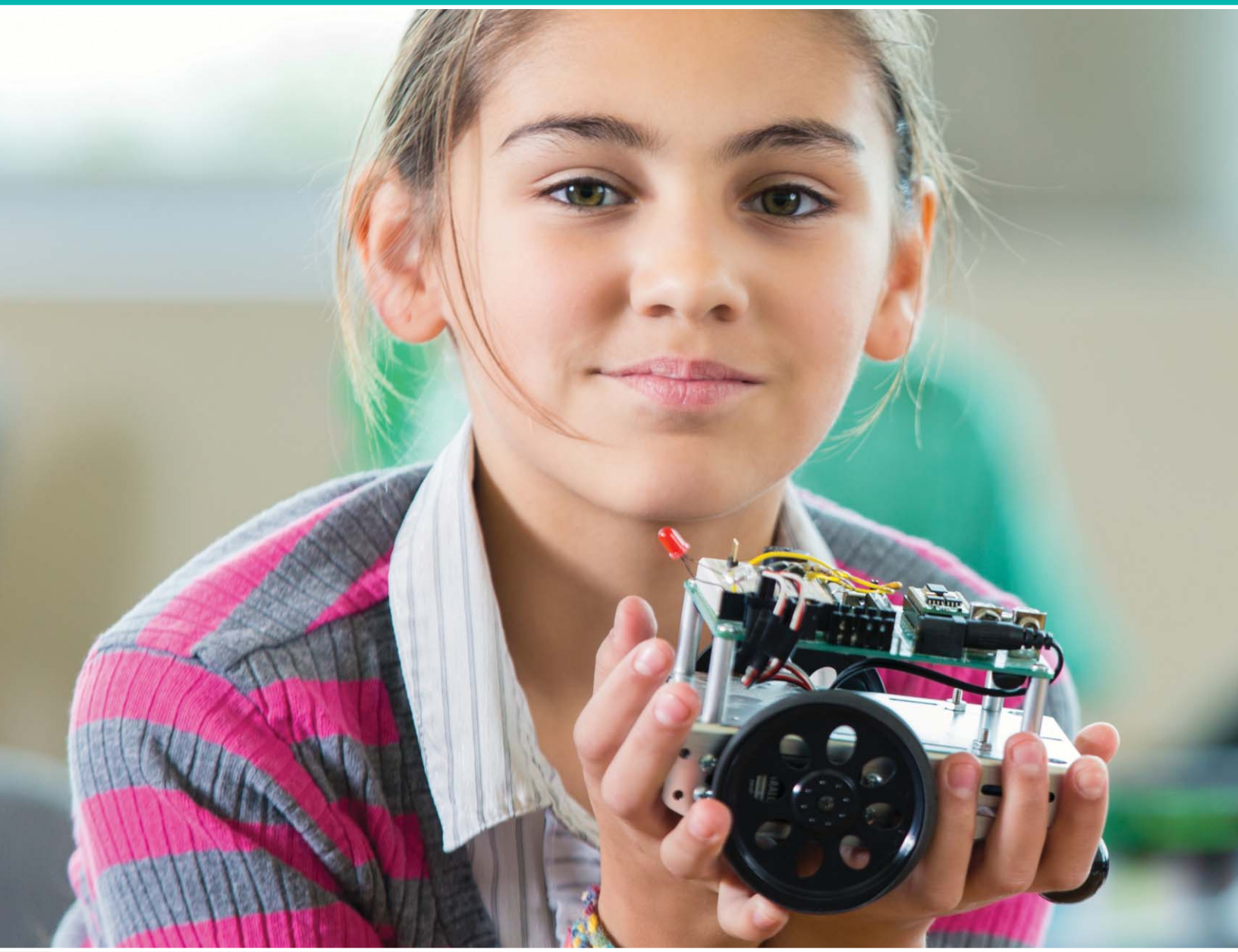

## idea packet

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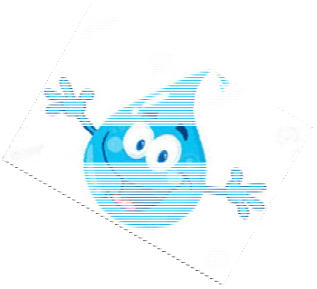
# Florida's Edible Aquifer

# Florida's Edible Aquifer

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**LESSON MODULE**

# Florida's Edible Aquifer

## *A Student Inquiry Project*

### GOALS & OBJECTIVES/ COMMON CORE STATE STANDARDS

**OBJECTIVES**

- Students will identify
  - Scientific theories are explanations and laws describe relationships, and both are supported by evidence.
  - Identify a benefit of using a model to explain how things work.
- Students will develop their sense of science process, investigation and data analysis and interpretation through
  - Personal research
  - Use of data findings through technology.

## FLORIDA STATE STANDARDS & NGSSS:

**CCSS: English Language Arts & MATH Standards 6-8:**

| | |
|---|---|
| LACC.6-8. | Standards for Literacy in History, Social Science, Science, and Technical Subjects |
| WHST.3.7 | Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. |
| RST.1.3 | Follow precisely multistep procedures when carrying out experiments, taking measurements, or performing technical tasks. |
| | Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. |
| RST.3.7: WHST.3.7 | Integrate quantitative or technical information expressed in words in a text with a version of information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). |
| LA.6.4.2.2 | The student will record information (e.g., observations, notes, lists, charts, legends) related to a topic, including visual aids to organize and record information and include a list of resources used |
| LA.6.2.2.3 | The student will organize information to show understanding (e.g., charting, mapping, paraphrasing, summarizing, or comparing/contrasting |

Math . 6-8:

| | |
|---|---|
| MA.6.A.3.6 | Construct and analyze tables, graphs, and equations to describe linear functions and other simple reactions using both common language and algebraic notation. |

| | |
|---|---|
| MS-ESS2-5 | Collect data to provide evidence for how the motions and complex interactions of air masses results in changed in weather conditions. |
| MS-ESS2-6 | Develop and use a model to describe how unequal heating and rotation of the Earth cause patters of atmosphere and oceanic circulation that determine regional climates. |

**Grade 8 Annually Assessed Benchmarks for the FCAT 2.0 Science Assessment Florida - Science: 6th - 8th Grade Next Generation Sunshine State Standards**

| | |
|---|---|
| **Big Idea 1:** | **The Practice of Science** |
| SC.6.N.1.1 | Define a problem from the seventh grade curriculum, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigation of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions. |
| SC.6.N.1.2 | Differentiate replication (by others) from repetition (multiple trials). |
| SC.6.N.1.3: | Distinguish between an experiment (which must involve the identification and control of variables) and other forms of scientific investigation and explain that not all scientific knowledge is derived from experimentation. |
| SC.6.N.1.4 | Identify test variables (independent variables) and outcome variables (dependent variables) in an experiment |
| SC.6.N.1.5 | Describe the methods used in the pursuit of a scientific explanation as seen in different fields of science such as biology, geology, and physics.<br>(ALSO SC6.7.N.3.2, SC.8.N.1.5, SC.8.E.5.10) |
| SC.6.N.1.7 | Explain that scientific knowledge is the result of a great deal of debate and confirmation within the science community. |
| | |
| **Big Idea 2** | **The Characteristics of Scientific Knowledge** |
| SC.6.N.1.5 | Recognize that science involves creativity, not just in designing experiments, but in also creating explanations that fit evidence. |
| SC.6.N.2.1 | Distinguish science from other activities involving thought |
| SC.6.N.2.2 | Explain that scientific knowledge is durable because it is open to change as new evidence or interpretations are encountered. |
| SC.7.N.3 | Identify that scientific theories are explanations and laws describe relationships, and both are supported by evidence.<br>Identify a benefit of using a model to explain how things work. |
| **Big Idea 3:** | **The Role of Theories, Laws, Hypotheses, and Models** |
| SC.6.N.3 | The terms that describe examples of scientific knowledge, for example; "theory," "law," "hypothesis," and "model" have very specific meanings and functions within science. |
| ***Big Idea 10:*** | ***Transformation of Energy*** |
| *Forms of Energy* | *Energy exists in many forms and has the ability to do work or cause a change.* |
| *SC.6.E.7.4* | *Differentiate and show interactions among the geosphere, hydrosphere, cryosphere, atmosphere, and biosphere* |
| SC.6.N.1.4 | Discuss, compare, and negotiate methods used, results obtained, and explanations among groups of students conducting the same investigation. |
| SC.8.N.1 | The Practice of Science - The processes of science frequently do not correspond to traditional portrayal of "the scientific method." |

**Course Outline/ Overview**

# Florida's Edible Aquifer

Students connect Language Arts and Science with critical thinking, through activities and "passionate causes". They can communicate information that they researched by publishing written documentation and producing recorded evidence through presentations. This promotes a deeper understanding of written communication and reasoning in students which can result in increasing test scores and achievements.

Students will be learning about where their water comes from and how important it is to take care of our environment. After reading, researching, discussing, and applying their new knowledge to their own lives, students will have fun in creating their models of edible aquifers with various scenarios for greater understanding of water as a natural resource and the impact of human populations, including pollution situations.

By understanding topics that affect their daily lives, students can have an impact on their global and community. They are motivated to promote an awareness of conservation and to make a difference through community environmental service programs. Teachers can tap into students' enthusiasm, with a process of relevant communication, learning through hands on inquiry and technology. Students can express their viewpoints through student projects, like videos to show evidence that supports their claims. Students are eager to communicate their findings of investigations and persuasive reasoning through videos.

This model integrates MDCPS District instruction of CER:

Claim – A conclusion that answers the original questions. Students need to make and accurate and complete claim.

Evidence – Scientific data that supports the claim. Students provide appropriate and sufficient evidence to support their claim, preferably empirical and validated data.

Reasoning – Justification that links the claim and evidence. It shows why the data count as evidence by using appropriate and sufficient scientific principles.

Using CER (Claim, Evidence, and Reasoning) is an effective way for students to communicate what they know, how they know it, and the evidence that supports their claim. They learn how to think and examine real life situations. Students become proactive in projects that can be empowering, through persuasive writing, multimedia communication, and documentation. Students become more aware of the need to practice effective writing through CER (Claim, Evidence, and Reasoning). They realize that learning can be fun and

effective, while personalizing it. Student performance increases in test scores with an approach of learning to have an impact and “make a difference”.

Students learn the process of application in evidential documentation and reasoning, in order to promote conservation of natural resources, energy, water, and wildlife. Constructing scientific explanations to support their claims in the process of Florida’s aquifer is important. This can be achieved more effectively by the construction of models. The application of models is more effective through relationships that students can understand. This is why their aquifer models are personally sized, transparent for easy observation, and fun, by using ingredients that are edible.

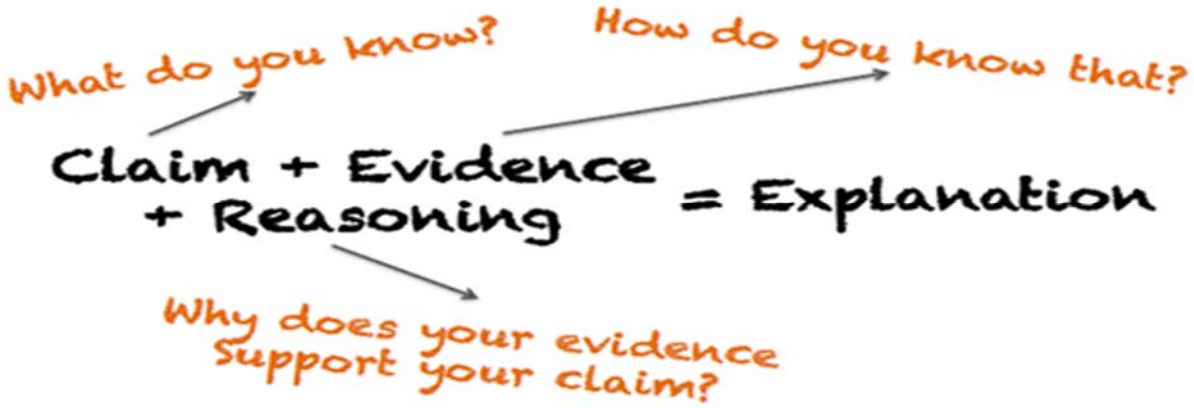
Anticipated Project Results:

Students examine guiding questions, “What choices can I make to make a better world? How can I contribute to the conservation of energy, natural resources, and wildlife? How can I help reduce the progression of climate change to improve our environment?”

Students use technology for modeling and presenting, to demonstrate an understanding about conservation from research and experiential learning strategies. This project can inspire and cultivate digital students to become environmental activists and innovators. Students become comfortable in accessing print and online publications that are related to science and technology, and may see how it can improve their lives.

Intended outcomes are measurable through product, publication and online information dissemination, increased student achievement, and understanding environmental and conservation programs. Future educational endeavors with active learning will improve progress in student achievements and assessments.

# *Essential Question Here*




*Courtesy of Miami Dade County Public Schools, District Office of Mathematics and Science*

**Claim**

**Evidence**

**Reasoning**

**Student Explanation**

## Lesson 1 Research-

### READING PASSAGES 1 & 2- Located in the Appendix A of this packet

**Objective:** Students will
-become familiar with water resources and aquifers for human supply & demand
-understand
-the components of aquifers, their structure, and process of water supply
-human impact on aquifers
-the process of research in Earth structures for water resources

**Procedure**:

Teachers teach the process of evidential literacy and show students how to support scientific inquiry investigations with documented evidence in multimedia formats. Students will team up in collaborative research groups to read an assigned section of the reading assignment. Student groups will then present to each other, summaries and evaluations of their research, with background information about aquifers.

Strategies that teachers use to support students in writing scientific explanations include: making an accurate and explicit framework in using models, making explanations understandable, providing a rationale for creating explanations, connecting evidence with reasoning to everyday explanations, and writing to provide feedback to students.

As students become more successful in reading, researching, and investigating scientific explanations, teachers introduce more complex tasks. Students can analyze data from evidence with multiple possible explanations.

The CER Process in writing about scientific investigations promotes more effective persuasive writing, which is important for helping students to become scientifically literate and critically evaluate scientific claims presented in popular cultures (e.g. Internet, journals, publications, and magazines).

In this lesson, students research and investigate environmental, scientific, and ecology issues through the use of interactive technology to access global resources. Students become familiar with concepts in literacy through science investigations by researching current events, collaborating on projects, writing articles, and using applications relevant in their lives through documentation of a variety of media.

Students learn about improving the quality of life through the applications of lessons and labs in Science, Language Arts, and community service projects with activities. Through Language Arts, students become capable of communicating their aspirations and claims, providing evidence from their activities, explaining their reasoning, persuading others to care enough about improving our world through conservation. Community service projects can empower students to research to make a difference in environmental concerns.

Suggested reading can be found on line with government publications, like Florida Department of Environmental Protection. See Appendix:
http://sr6capp.er.usgs.gov/aquiferBasic/ext_Floridian.html
http://www.floridasprings.org/learn/journey/
Extension Activity for student model demonstrating AQUIFERS **http://www.groundwater.org/kc/activity2.html**

## **Lesson 2***: The Florida Aquifer*

**http://www.cpalms.org/Public/PreviewResourceLesson/Preview/128943**
Resource ID#: 128943
This is a two-day lesson that addresses the correlation between the annual rainfall and the human impact upon the Florida aquifer.
**Subject(s): Science** **Grade Levels: 6-8**
**Suggested Technology:** Computers, Projector, Microsoft Office, Smart Phone or Tablet
Instructional Time: 2 Hour(s)
**Keywords:** Florida aquifer, atmosphere and hydrosphere, climate and rainfall
Resource Collection: FCR-STEMLearn Earth Systems
See Appendix for Rubric Rubric.docx

**LESSON CONTENT-** The Florida Aquifer Data Correlations
**Objective:**
The students will be able

-to create correlations between: the annual rainfall affects the water levels in the Floridian aquifer and use of the aquifer for human resources with the depletion of the Floridian aquifer water table.

-explain the hydrologic cycle.

- state that the heat of the sun provides energy to make the water cycle work. This heat energy causes evapotranspiration, sublimation, and evaporation to occur, thus forming condensation to yield precipitation and restarting the process.

**Background information - research and discuss**
Where are the storage places or reservoirs for Earth's fresh water?
What are origins of our fresh water sources in Florida? *Rivers, lakes, streams, rainfall*
What is an aquifer?

An aquifer is an underground layer of water-bearing rock. Water-bearing rocks are permeable, with openings that liquids and gases pass through. An aquifer fills with water from rain or melted snow that drains into the ground.

Water passes through soil on top of the aquifer; or enters through joints and cracks in rocks. Water moves downward until it meets less permeable rock.

Aquifers act as reservoirs for groundwater. Water from aquifers sometimes flows out in springs. Wells drilled into aquifers provide water for drinking, agriculture, and industrial uses. Aquifers can dry up when people drain them faster than nature can refill them.

**Student discussion:**
What would you do if you turned on the tap in your home and no water flowed?
Students will watch the Huffington Post video "Florida Springs, Aquifer, And Drinking Water In Environmental Crisis," record notes in their science notebooks, and be ready to share their findings in their cooperative groups. The teacher will randomly select a student from teams to report their findings.
http://www.huffingtonpost.com/2012/11/26/florida-springs-in-enviro_n_2193378.html

The teacher will show the class a map of the Floridian aquifer.

**Activities:**
Demonstrating how to set up data on an Excel spreadsheet, teacher and students will brainstorm topics for sets of data to be averaged and placed on a scatter chart.
The teacher will model how to vet valid sources of data.

The students will then research three sets of data, collect data on a spreadsheet, and create a scatter chart to display their data.
Students will
-need access to electronic devices.
- locate and print out a current map of the Florida aquifer.
- gather data on the water tables of the Florida aquifer for the last five years.
- gather data on the annual rainfall for Florida for the last five years.
- gather data on the amount of water from the aquifer used by humans over the last five years.
- create an Excel spreadsheet and a graph for the specified time period.

Students should conduct research to find their own sources, but the following sites are possible sources for students who are struggling:
Groundwater levels - http://fl.water.usgs.gov/infodata/groundwater.html
Rainfall - http://flame.doacs.state.fl.us/fire_weather/fmis_rainfall.html
Water usage - http://fl.water.usgs.gov/infodata/wateruse.html

**Closure:**
After the students have collated the data on a scatter chart, they will formulate and write their conclusions, to share in a class discussion.

**Summative Assessment**
Students write an analysis of data collected and draw a conclusion based upon the analysis. Students evaluate the quality of their work, using a rubric based on accuracy of data collection, graphic displays, and data analysis (see attachment for rubric)

### *Feedback to Students*
*What are you noticing about the amount of rainfall in the area of the Floridian aquifer and the water table level?*
*What is a cause and effect relationship between the water table level and the depletion of the Floridian aquifer?*
*What human activities contribute to its depletion?*
*What are some checks and balances that should be put in place to keep the water table levels sufficient for our use?*

### *Accommodations:*
*The lesson can be modified to give varying levels of support.*
*Lower level students may need more support instruction or peer tutor help during the activity, while higher level students should be given the opportunity to extend the lesson and share their findings. Lower level students can be shown websites to assist in explaining the data collected.*

*Extensions:*
*Sinkholes: Students could explore the correlation between limestone formations and ground water.*

Materials Needed: Students need access to Internet connection.
SOURCE AND ACCESS INFORMATION:
**http://www.cpalms.org/Public/PreviewResourceLesson/Preview/128943**
Resource ID#: 128943

Access Privileges: Public

| |
|---|
| ***Research Question:*** |
| ***Claim:*** (Make a statement that answers the research question, based on what you observed in the lab you performed) |
| ***Evidence:*** (Support your claim by citing data you collected in your lab procedure) |
| ***Reasoning:*** (Describe the science concepts that explain why or how the evidence you presented supports your claim) |

## Lesson 3: Research & Scientific Method using CER in Aquifers Model-

Students wonder where all of the water comes from for human consumption?

**Purpose of the Lab/Activity:**

Students will create an Edible Aquifer to demonstrate the function and process of groundwater as a resource.

After Lesson 1 and Reading Passages 1 & 2, students will discuss aquifers and follow up with this hands-on activity to demonstrate the structure of an aquifer.

**Overview:** Each student will create their own aquifer model in a transparent glass using edible ingredients. Each ingredient layer will represent a layer, or section of an aquifer, showing students how groundwater travels through the structure. This activity may also demonstrate how pollution can contaminate groundwater and damage water resources. Conservation of water and water quality is emphasized in this topic to teach about human impact on water and natural resources

**Vocabulary:**

Aquifer, confined layer, groundwater, porous, saturated, water table, recharges

**Materials:** Clear plastic cups, straws, crushed ice, vanilla ice cream, lemon line soda or ginger ale, Chocolate & colored sprinkles, chocolate syrup, green colored coconut,

**Procedure:**

1. Each student starts with a clear plastic cup and napkin.
2. Add a layer of crushed ice, or chocolate chips to the 1/3 bottom of the cup. *(Rocks underground the aquifer)*
3. Pour the soda over the ice to the same level of the ice. *(Ground water)*
4. Add a layer of ice cream. *(Confining layer- usually clay or rock making it difficult for water to soak through, and helps restrict contamination)*
5. Add Sprinkles over the ice cream. - Chocolate sprinkles *(soil)*
   Green coconut *(grass and other plants)*
6. To get water out of the "aquifer", students will drill a well with a straw.
7. Students sip up the liquid, simulating a well as they pump the liquid from their edible aquifer.
8. Squeeze some chocolate syrup &/or colored sugar sprinkles over the aquifers. *(Pollution, contaminants, oil, gasoline, pesticides, fertilizer toxins)*

*This represents toxins and pollution through improper disposal or water runoff with harmful toxins and chemicals, like green blue algae and trash, plastic and petroleum products.*

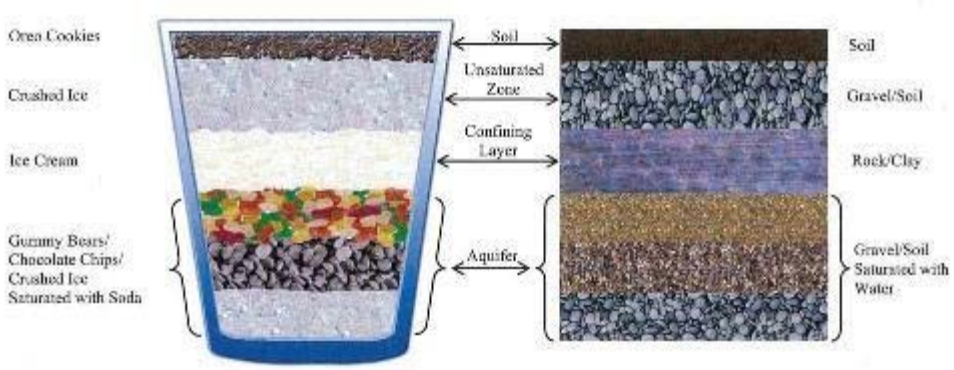
9. Pour the clear soda. *(rain runoff, penetrating, and infiltration of rain water that runs through the soil to recharge the aquifer)*

10. Discussions and simulation tests of pollution of an aquifer and water supply, including recommendations of how to protect groundwater in aquifers, are shared among students. Show the process if water is sucked up the “well” and not replenished with fresh rain water.

Students may conclude that the aquifers are limited and we need to only use what we need- Reduce, Reduce, reuse, recycle.
Reduce and prevent pollution for water quality.

http://faitc.org/wp-content/uploads/2013/08/Edible-Aquifer.pdf
http://faitc.org/edible-aquifer/
http://www.savingh2o.org/resources.html

## Samples of Edible Aquifers




**See map of Ogallala Aquifer with state relationship in Appendices**

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## *LESSON 4 CONTENT- Engineering Design Model: Hands-On Open Inquiry*

## The Challenge WE-LAB Activity– Building a Model Aquifer

(http://dreamingreen.org/we-lab/)

**OVERVIEW:** Only one tablespoon in every gallon of water on earth is fresh water (called potable water). The remaining water is salty, or frozen as ice.

In Miami-Dade County, the majority of fresh water is supplied by the Biscayne aquifer. Students will build a working model of an aquifer to describe how ground water flows through the Biscayne aquifer, how ground water can become contaminated, and why it is so difficult to clean contaminated ground water. Students will study watershed models, design and create a watershed model out of recycled materials to understand water runoff and the impact of heavy rains on soil.

Although almost half of all Americans get their drinking water from wells, many people have never heard of ground water. The use of ground water supplies increases at twice the rate of surface supplied water, with the trend expected to continue.

**OBJECTIVE:** Students will use a model of an aquifer to describe how ground water flows through an aquifer, how groundwater can become contaminated, and why it is so difficult to clean contaminated ground water.

**Activity Description:**

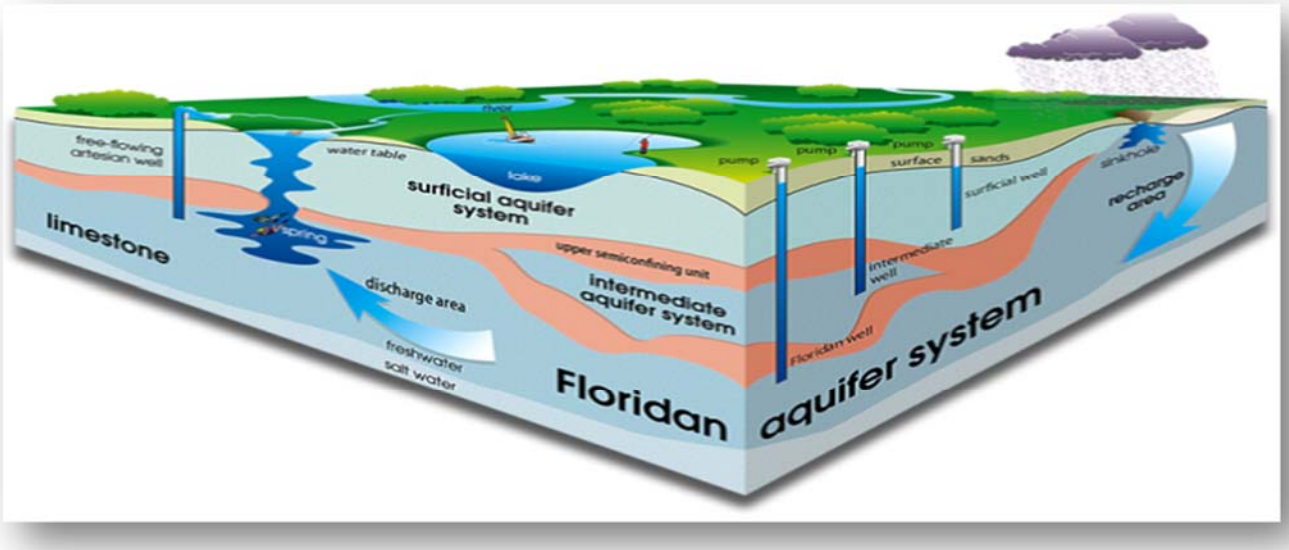
The use of ground water is increasing at twice the rate of surface water, and the trend is expected to continue. Until the late 1970's, it was widely believed that ground water was protected from contamination by the natural filtering effect of the many layers of soil, sand, gravel and rocks. We now know that pollutants can travel through all these layers. Incidents of serious contamination have been reported in every state in the nation.

A model can be a very flexible tool which will allow students to simply study groundwater flow, look at how well placement affects yield, or examine how ground water is vulnerable to contamination.

For primary schools, each student can use a cup to build their own model aquifer. For secondary schools, the teacher may lead groups of four or five students in building their own models, or the teacher may build a single, larger (the larger the better) version for demonstration, like an aquarium, a large plastic container, or large clear Plexiglas structure. Students present their aquifer model to classes.
When completed, students present their model aquifer to the class.

**Primary Schools Activity Details:**
http://water.epa.gov/learn/kids/drinkingwater/upload/2005_03_10_kids_activity_grades_k-3_aquiferinacup.pdf

**Secondary Schools Activity Details:**
http://water.epa.gov/learn/kids/drinkingwater/upload/2009_04_29_kids_activity_grades_9-12_buildingamodelaquifer.pdf



## LESSON 5:

### How to create a Public Service Announcement
### Create a Water Conservation Public Service Announcement

**Objectives:** Students will become familiar with digital technology through the planning and designing components of public service announcements.

**Overview:**

Student groups will create a Public Service Announcement (PSA) with a water conservation message. The PSA should motivate students and community to take actions to protect this precious resource and stress the consequences of water waste.

Students will research and share information about water conservation efforts conducted throughout the United States. Collaborating in small groups, information should include explain how water resources are related to aquifers, how life is dependent on them, and successful practices of water conservation.

Through multimedia videos, students report the importance of aquifers as a water resource, showing evidence and stating their reasoning to support their CER Claim.

**Background:**

A Public Service Announcement (PSA) can be written or presented in audio or visual form. Public service announcements are usually transmitted electronically, via Internet, radio, television, in a short spot of ten to sixty seconds.

A public service announcement typically educates and raises awareness in a community topic, usually, but not always, for a non-profit organization. There are many science competitions for videos that promote environmental concerns and conservation (SECME, Dream in Green, Fairchild Botanical Gardens, and District Science Office for MDCPS).

PSAs cover "who, what, where, when and why." Be responsible for the audience and focus on the purpose of the PSA. An on camera interview of a student or professional representative can announce the issue or concern. Students submit video that are appropriate in quality and content.

**Activity Description:**

Student groups responsible for creating a PSA will generate awareness in a theatrical manner. They should research ways in which a person wastes water. The goal of presentations is to increase the awareness of what is good and bad for the environment.

The techniques of writing a PSA differ from media to media. Use the following basics as your guide.

Put “PUBLIC SERVICE ANNOUNCEMENT” at the top middle of the single sheet of paper. Type student name(s), school name, and contact person. In bold letters, type the topic followed by a short, concise explanation of what the PSA is focused on.

Students need to practice and plan ahead of time.
What do students want to educate or make the audience aware of?
Make it legible, visually attractive and pleasing to the eye, and intense, in 30-60 seconds.

Guidelines:
1. In a team, create a Public Service Announcement with a green message
2. Research to motivate people to make behavioral changes to influence such changes
3. The PSA should be between 30 seconds to less than 3 minutes long
4. Video record or take pictures of what was done in the CER project with narrations.
5. Storyboard the PSA design / plans
5. Promote the PSAs on school websites and social media of conservation programs like Dream in Green, Fairchild Challenge, SECME, Science competitions.

Software programs for your computer *(Selections will vary)*
Movie Maker (Windows)
iMovie (Mac)
Apps for you smart phone: iMotion HD (iOS: Free), Magisto Video Editor & Maker (Android: Free), Andromedia Video Editor (Android: Free)

Materials:
Paper/ Pencil- for script & storyboard
Timer
Digital Camera / Cellular phone- Smart phone
Computer

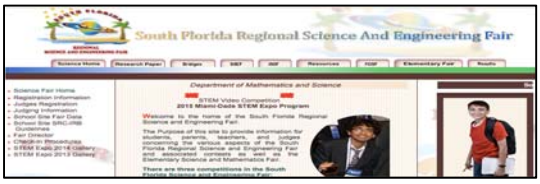
How to Write Public Service Announcements
1. Have a plan or an issue that you feel strongly about. Students should request information about topic research and review specific requirements, restrictions and limitations of PSAs, along with a sample PSA.
2. Research other PSAs on television, radio, and Internet
3. The length of the PSA option (30-, 60-, 90-second spots) in planning.
4. Write down the key points that must be covered with the PSA. Always try to answer the obvious questions of who, what, when, where, why and how.
5. Capture the audience's attention at the beginning of the PSA. This can be done with music, humor, image, or a quotation, by asking a question. Make it a thought-provoking statement, by sharing a fact, or any other method that will make the audience want to listen. That will become the first part of the PSA.
6. Storyboard or draft the PSA with all components in place. Use words that will attract the public’s attention and compel them to listen. Example: Our home and Florida, we need to conserve our water.

7. Time the drafted PSA to make certain that it fits within the time frame allowed.
Assessments: Provide the CER rubrics and include guidelines based on choice of media, digital, video, PowerPoint, or type of Public Service Announcement.

Assessment is based on completion of project according to guidelines and collaboration with group partners.

**Presentations:** Activity can be used in Green School Challenge Program for Water & Energy Conservation.

www.dreamingreen.org



www.science.dadeschools.net

Dream in Green Program/ Green School Challenge/ WE-LAB is free environmental program.

Dream in Green WE-LAB Program helps build leadership experience, as a collaborative team to resolve environmental hot topic issues and implement a green school atmosphere. Students and teachers are trained to learn how to conserve energy, improve efficiency, and save in the expenses of school and homes. Student driven projects promotes motivation to continue learning about natural science and the environment through action and behavior.

Objectives of this program and science labs develop skills to implement environmental education programs to promote energy and water conservation and efficiency, environmental sustainability, and the use of renewable energy in the public and private sectors, to raise awareness and deepen understanding of the energy, climate change and environmental issues confronting local and global communities.

# References


http://coastgis.marsci.uga.edu/summit/aquifers_fla.htm

http://www.cpalms.org/Public/PreviewResourceLesson/Preview/128943

www.dreamingreen.org

http://earth.rice.edu/MTPE/bio/biosphere/topics/energy/40_biomass.html

http://www.epa.gov

http://faitc.org/edible-aquifer/

http://fcit.usf.edu/florida/lessons/water/water.htm

http://www.floridasprings.org/education/

http://www.floridasprings.org/learn/journey/

http://fcit.usf.edu/florida/lessons/sup.htm#water

http://www.nationalgeographic.com/

http://www.odysseyearth.com/

http://www.savingh2o.org/resources.html

www.science.dadeschools.net/CER

www.science.dadeschools.net Miami Dade County Public Schools. District Office of Mathematics and Science

http://sofia.usgs.gov/flaecohist/kidscorner/Modified with permission from Global Climates - Past, Present, and Future, S. Henderson, S. Holman, and L. Mortensen (Eds.). EPA Report No. EPA/600/R-93/126, U.S. Environmental Protection Agency.

http://sr6capp.er.usgs.gov/aquiferBasic/ext_Floridian.html

http://www.swfwmd.state.fl.us/publications/files/flas_aquifers.pdf

http://umaine.edu/mitchellcenter/files/2012/06/Lesson-One_AQUIFERS.pdf

http://www.virginia.edu/blandy/blandy_web/education/Bay/EdibleAquifers_Revised2012.pdf

http://we-lab.net/wp-content/uploads/2016/01/Guidebook-WE-LAB-Dec..pdf

***APPENDIX***

***STUDENT HANDOUTS***

***RUBRICS***

# Reading Passage1: Florida Aquifer- Aquifer Basics

The Floridian aquifer system is one of the most productive aquifers in the world. This aquifer system underlies an area of about 100,000 square miles in southern Alabama, southeastern Georgia, southern South Carolina, and all of Florida. The Floridian aquifer system provides water for several large cities, including Savannah and Brunswick in Georgia; and Jacksonville, Tallahassee, Orlando, and St. Petersburg in Florida. In addition, the aquifer system provides water for hundreds of thousands of people in smaller communities and rural areas. Locally, the Floridian is intensively pumped for industrial and irrigation supplies. During 1985, an average of about 3 billion gallons per day of freshwater was withdrawn from the Floridian for all purposes. Withdrawals during 1988 were somewhat greater. Despite the huge volumes of water that are being withdrawn from the aquifer system, water levels have not declined greatly except locally where pumpage is concentrated or the yield from the system is minimal.

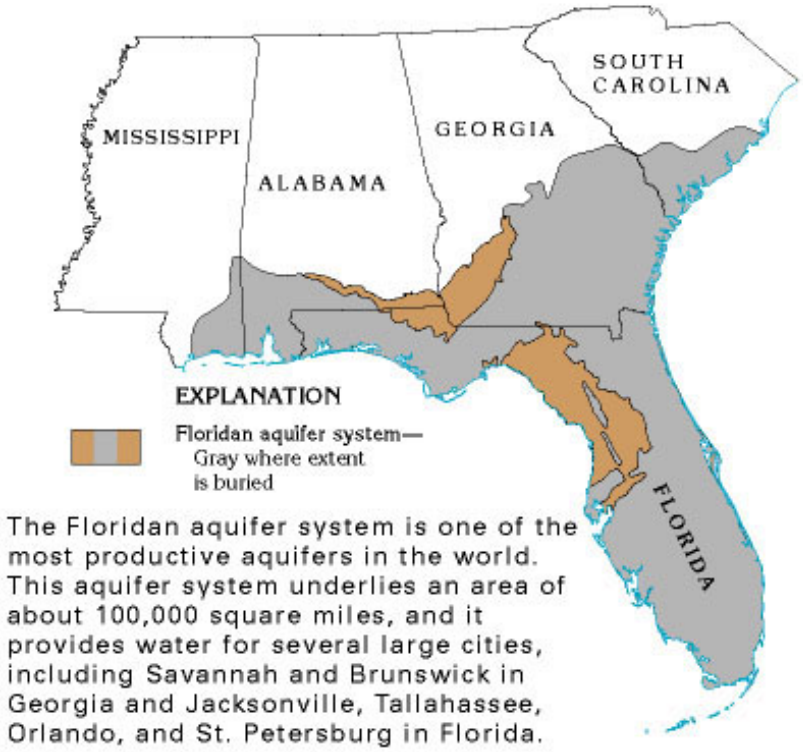
A thick sequence of carbonate rocks (limestone and dolomite) of Tertiary age comprises the Floridian aquifer system. The Floridian aquifer system has been defined on the basis of permeability. In general, the system is at least 10 times more permeable than its bounding upper and lower confining units. The aquifer system is thick and widespread, and the rocks within it generally vary in permeability. In most places, the system can be divided into the Upper and Lower Floridian aquifers, separated by a less-permeable confining unit.

The Upper Floridian is highly permeable in most places and yields sufficient water supplies for most purposes, and there is no need to drill into the deeper Lower Floridian aquifer. The confining unit separating the Upper and Lower Floridian aquifers, informally called the middle confining unit (or semi-confining unit where it allows water to leak through it more easily), is present at different altitudes and consists of different rock types from place to place. At some locations, the confining unit consists of clay; at others, it is a very fine-grained (micritic) limestone; at still other places, it is a dolomite with the pore spaces filled with anhydrite. Regardless of rock type, wherever the middle confining unit is present, it restricts the movement of ground water between the Upper and Lower Floridian aquifers.

The geologic characteristics and hydraulic properties of the Lower Floridian aquifer are not as well-known as those of the Upper Floridian aquifer because the Lower Floridian is at greater depths, and, therefore, fewer borehole data are available. The Lower Floridian includes the lower part of the Avon Park Formation, the Oldsmar Limestone, and the upper part of the Cedar Keys Formation. Much of the Lower Floridian aquifer contains saltwater. Two important, highly permeable zones are present within the Lower Floridian. One of these is a partly cavernous zone in northeastern Florida and southeastern coastal Georgia, called the Fernandina permeable zone, named after the Fernandina Beach area of Nassau County, Fla.

This zone is the source of a considerable volume of fresh to brackish water that moves upward through the middle semi-confining unit and ultimately reaches the Upper Floridian aquifer.

Before development, nearly 90 percent of the discharge from the Floridian aquifer system was to springs and streams. Upward leakage across confining units, especially in coastal areas, accounted for slightly more than 10 percent of the discharge. Discharge to offshore springs was common on both the gulf and ocean sides of the northern part of peninsular Florida where onshore hydraulic heads were 10 feet or less. Contours that extend offshore from coastal Georgia and adjacent northeastern Florida are based on freshwater heads measured during recent test drilling.




The Floridan aquifer system is one of the most productive aquifers in the world. This aquifer system underlies an area of about 100,000 square miles, and it provides water for several large cities, including Savannah and Brunswick in Georgia and Jacksonville, Tallahassee, Orlando, and St. Petersburg in Florida.

**Source:** *http://sr6capp.er.usgs.gov/aquiferBasics/ext_floridan.html*

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http://sr6capp.er.usgs.gov/aquiferBasic/ext_Floridian.html

## Reading Passage 2: The Journey of Water

# *The Journey of Water*

To understand Florida's springs and their importance as natural resources, we must first understand the water cycle and aquifer that sustains them.

The information below is derived from the **Interactive Journey of Water**.
http://www.floridasprings.org/learn/journey/

Presented by Florida Department of Environmental Protection



## Getting to the Source of Springs

Contrary to popular belief, Florida's springs are not the source of freshwater; they are but one step on water's long journey through what is known as the Floridian Aquifer, our underground water source. Learn about the water cycle and the flow of water through the aquifer to gain a better understanding of Florida's springs. Also, learn more about how humans impact the quality and quantity of water in the aquifer and ultimately in the springs.

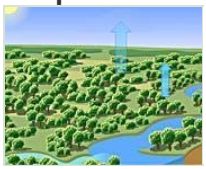
### Water Cycles Around

The journey of water begins in the sky, where the state's abundant rainfall recharges the Floridian aquifer, our underground water source. Read below to learn about the water cycle and how it contributes to spring formation.

**Rainfall**

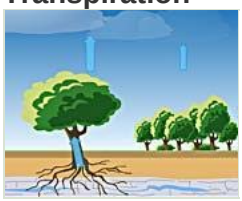
Rainfall is a function of various atmospheric and physical factors, and the most important of these are gravity and humidity. As the tiny water droplets within a cloud merge together into larger, heavier drops, they eventually overwhelm the relative level of atmospheric humidity that keeps them airborne. Relative humidity is a measurement of the amount of water the air can hold at a given temperature. Scientists have recently determined that once these drops reach a diameter of twenty millimeters, rain will begin to fall. Every day, over 150 billion gallons of rain falls in Florida, more than any other state in the nation except Louisiana.

**Evaporation and Condensation**



Water's journey through the water cycle begins with a process called evaporation whereby water stored in surface bodies of water like lakes, rivers and the ocean is converted into water vapor by the heat of the sun. Convection then draws this warmer, wetter air upwards where it comes into contact with cooler, high atmospheric air and eventually condenses back into tiny water droplets. Collectively, these tiny droplets are called clouds.

**Transpiration**



In addition to evaporation, a significant percentage of the water is released into the atmosphere by trees and plants in a process called transpiration. In order to facilitate photosynthesis, plants absorb water from the soil through their roots, a process that can also clean water by filtering out nutrients and pollution. They then transpire this water back into the atmosphere through their leaves and stems. About 70 percent of all rainfall returns to the atmosphere in the form of evaporation and transpiration.

**Runoff**

Rainfall that is not absorbed directly into the soil, through the roots and leaves of plants, or accumulated into existing bodies of water such as lakes or rivers is called surface, or storm water runoff. In areas where the underlying geologic formation is impervious to water, as in the case of clay, runoff is a natural process, directing water in sheet flow, into lakes, rivers, wetlands, and the ocean. In Florida, where loose sandy soils and porous limestone bedrock are common, rainfall that reaches the surface of the earth usually soaks directly into the ground.

**Percolation**

Rainfall seeps underground through a process called percolation, whereby water travels downwards through the tiny spaces between rocks and soil particles, and within the "Swiss cheese" structure of the limestone. The water eventually saturates the underlying limestone in much the same way water fills the tiny holes of a sponge. It is this process of percolation that allows Florida's abundant rainfall to replenish the immense volumes of water flowing from the springs.

**Rain Falls Again**

Though the first step of water's journey to the springs begins in the sky, the water cycle itself is a never-ending process, and no single step is more important than any other. Evaporation, transpiration, condensation, rainfall, run-off, and percolation all play a critical part in ensuring that water is consistently available for both natural processes and human use.

## From Aquifer to Springs

The source of our drinking water and the crystal clear water in springs is the Floridian Aquifer, nature's underground water storage system.

**Recharge Basin**

Water begins its journey underground to the aquifer by a process known as recharge whereby rainfall seeps underground to infiltrate the limestone below. The overall land surface area where water seeps underground and contributes rainwater to a specific spring is called a spring's recharge basin. North-central Florida, where spring upwellings are most abundant, contains hundreds of recharge basins. Given their complex three-dimensional structure, recharge basins are determined through extensive scientific studies of local subsurface geology and groundwater flow.

**Percolation**

Percolation is the physical process by which rainwater falling within a given recharge basin slowly travels underground through the tiny spaces between rocks and soil particles. Florida's unconsolidated, sandy soils as well as the porous nature of the limestone aquifer itself provide the ideal conditions for unrestricted percolation. Yet, depending on the type of soil and the depth of the limestone aquifer, some areas allow water to percolate water underground faster than others, resulting in different recharge rates. Areas of high recharge occur in only 15 percent of the state, mostly in the sandy highlands of west and west-central Florida.

**Speleogenesis**

Speleogenesis is a big word that describes the formation of caves. In Florida, speleogenesis occurs underground through a simple chemical reaction. As rainwater falls through the atmosphere and percolates through the soil, it combines with carbon dioxide in the air and decaying vegetation to form a mild carbonic acid that slowly dissolves the limestone enlarging small cracks and pores. Over thousands of years, these small pores and cracks expand to become underground caves and caverns. Collectively, these interconnected caves are the pipes through which groundwater flows within the aquifer to the springs.

**Groundwater Flow**

Gravity is the major force in groundwater movement in the aquifer. Under natural conditions, groundwater moves "downhill" until it reaches the land surface at a spring or through a seep in a riverbed, lake or wetland. The speed with which water flows through the aquifer is also dependent upon the porosity and permeability of the limestone. In other words, water flows more quickly if the spaces or holes in the limestone are larger and if these spaces are closely connected to allow water to flow through.

**Sinkholes**

Sinkholes are depressions in the land caused by dissolution of the limestone near the surface or the collapse of an underground cave. Once these "windows" to the aquifer are open, they may provide direct access to the conduits through which water flows from the recharge basin to the springs themselves. As a result, they are one of the most common points of entry for cave divers seeking to explore and study the underground aquifer.

**Spring Formation**

Springs form where groundwater is forced up and onto the surface through openings in the ground. This is caused by the differences in the slope or "hydraulic gradient" in the aquifer. As rain falls and percolates underground, it exerts pressure on the water already in the aquifer, forcing some to the surface through natural openings. The highest concentration of springs in Florida lies in the north-central part of the state where the aquifer is closest to the surface. Springs are classified or categorized based on the amount water discharge. The largest springs like Wakulla and Silver Springs are classified as "magnitude 1" springs which means they each discharges more than 65 million gallons of water a day - the equivalent of about 1.3 million bathtubs full!

**Spring Flow**

The volume of water flowing from a spring is dependent upon a variety of factors: the water pressure in the aquifer beneath it, the number of caves leading to the spring vent or opening, and the size of the vent itself. Florida's springs are the largest by volume in the world, giving birth to and supporting entire river eco-systems like the Suwannee and the Santa Fe. Collectively, Florida's springs discharge over 19 billion gallons of freshwater each day.

# Human Impact

Every day in Florida, more than 7 billion gallons of water are consumed, most of it withdrawn from the aquifer. In addition, harmful fertilizers, chemical pesticides and other pollutants that are introduced to the land make their way into our groundwater supply and eventually the springs.

**Landscaping and Lawn Care**

Certain methods of lawn care and landscaping can have a detrimental impact on Florida's aquifer and springs because they require frequent applications of chemical fertilizers and pesticides. These chemicals introduce toxins and nitrates into the aquifer, polluting our drinking water, contributing to nuisance algae growth, and endangering wildlife species in the springs.

Conventional landscaping and residential lawn care also consume large amounts of water due to the need for regular irrigation. Nearly fifty percent of all water withdrawn for public supply is used solely to water residential lawns-an estimated 900 million gallons a day.

**Row Crop Agriculture**

Agriculture impacts both the quality and quantity of water flowing underground. Every year, millions of tons of fertilizers and pesticides are applied to crop fields, a significant percentage of which ends up leeching into the aquifer. Like chemicals used in residential landscaping, these fertilizers and pesticides can have a significant impact on springs as well as our drinking water.

Crops also consume large quantities of water removed from the aquifer - more than 1.5 billion gallons of water each day. A single center-point irrigation system on a typical Florida farm may use over one million gallons of water per day.

**Livestock**

Large livestock farms can have a direct impact on both the quality and quantity of underground water. Large quantities of animal wastes can enter the aquifer through surface streams, sinkholes, and swallet holes, as well as percolate through Florida's porous soils.

Weeks, months, and sometimes even years later, these contaminants end up in our drinking water and in the springs where we swim. Livestock also consume large quantities of water in addition to feed that must be grown with irrigated water drawn from the aquifer.

**Sprawl and Development**

Since 1950, Florida's population has grown four-fold. The rate of increase shows no sign of leveling off; even today, 750 new residents move into the state each day. This rapid increase in population has led to development and sprawl in rural areas that were once dominated by forests and farms. The resulting changes in land use have had a dramatic effect on the health of the recharge basins for many springs. Demands for residential water, increasing storm water runoff and intensifying direct human impact at the springs have all contributed to the decline in their conditions.

**Runoff and Storm water**

An average of 150 billion gallons of rain falls each day in Florida. Where this water is not soaked into the soil, absorbed by plants, or gathered into existing bodies of water, it is diverted from parking lots, roads and highways to reduce the risk of flooding. The process is called storm water management. However, once diverted, storm water and everything it carries with it does not go out of our lives. Storm water washes heavy metals, petroleum by-products, pet wastes, and toxins from the land unfiltered through a complex system culverts, drainage ditches, and retention ponds. Some of these pollutants wash into rivers and streams and percolate into the aquifer and our drinking water.

**Golf Courses and Athletic Fields**

Recreational sports like golf and football are a way of life in Florida. Yet, they have unseen, detrimental impacts on the aquifer. Golf courses and athletic fields often require specialized strains of grass that demand excessive irrigation, fertilization, and pesticide use. With regular rainfall, these chemicals leech through the root systems and soil, and eventually into the aquifer.

The development of golf courses and athletic fields in areas previously covered with native forest can also have a negative impact on the recharge basins of springs by increasing surface runoff, soil erosion, and direct human impacts.

**Human Consumption and Overuse**

Every day in Florida, over 7.2 billion gallons of freshwater are consumed directly by humans to satisfy the demands of agriculture, industry, power plants, development, and municipal and public water supplies. On average, each Florida resident uses about 103 gallons of water per day. More than 60 percent of this water is pumped directly from deep underground aquifers. That's about four billion gallons, enough to fill the Gator Bowl nearly full daily for a year!

As a result, we are withdrawing water from Florida's underground aquifer faster than it can be replenished, decreasing flow levels at many head springs, stressing sensitive spring plant and animal species, and causing permanent, long-term damage to the geologic structure of the aquifer itself.

**Illegal Dumping**

Sinkholes are formed when the limestone above a conduit or cave in the aquifer collapses. They may form over many years or may form suddenly as a result of too much water being drawn from the aquifer and from natural causes. The sinkhole may or may not be filled with water but almost always feeds directly into the aquifer below. In many cases, residents have dumped debris ranging from construction materials, garbage, refrigerators, automobiles and chemicals. Dumping anything into sinkholes can seriously impact the aquifer and water supply.

**Recreational Impact**

Recreational activities like camping, swimming, tubing, and boating can have a direct impact on the water quality of the springs as well as the animals and plants that live there. These impacts include the trampling of native vegetation, the disturbance of wildlife, an increase in soil erosion, and direct physical damage to plants and animals by boat props, groundings and anchors. Trash left behind at the springs not only introduces pollutants, but also destroys the natural look and atmosphere of the spring's environment.

## Science Rubric

Exceeds - must receive no more than one 3 and the rest 4s in the other areas of the rubric.
Meets - may receive no more than one 2 and a combination of 3s and 4s in the other areas of the rubric.
Approaches - may receive no more than one 1 and combination of 2s, 3s, or 4s, in areas of the rubric.
Begins - must receive at least a 1 all 3 areas of the rubric.

| | **Knowledge**<br>Knows and understands scientific terms, facts, concepts, principles, theories and methods | **Application**<br>Applies scientific knowledge, skills and methods to manipulate, analyze, synthesize, create and evaluate | **Communication** |
|---|---|---|---|
| 4 | Descriptions of scientific terms, facts, concepts, principles, theories and methods are complete and correct | Applications are thorough, appropriate, and accurate. | Written, oral and/or visual communication is well organized and effective |
| 3 | Descriptions of scientific terms, facts, concepts, principles, theories and methods are somewhat complete and correct | Applications are mostly thorough, appropriate and accurate | Most of the written, oral and/or visual communication is well-organized and effective. |
| 2 | Descriptions of scientific terms, facts, concepts, theories and methods are somewhat complete and correct. Applications are thorough, appropriate, and accurate. | Applications are somewhat appropriate and accurate. | Some of the written, oral and/or visual communication is organized and effective. |
| 1 | Descriptions of scientific terms, facts, concepts, principles, theories and methods are minimally present or correct | Applications are minimally appropriate and accurate | Little of the written, oral and/or visual communication is organized and effective. |
| 0 | All the descriptions of scientific terms, facts, principles, theories and methods are missing and/or incorrect | All applications are missing and/or incorrect. | All of the written, oral or visual communication is missing and or lacks organization. |
| Score | | | |

TOTAL SCORE: _____

http://www.cpalms.org/Public/PreviewResourceLesson/Preview/128943

# *Scientific Explanations*

# CLAIM

**What is a Claim?**

A claim is a statement about what you know and are trying to help others understand.

How to write your claim:

- Use one complete sentence.
- Use descriptive words.
- Answer the question.

# EVIDENCE

**What is Evidence?**

Evidence is data used to support the claim. The evidence tells the audience the support you have collected that makes the claim convincing.

How to write your evidence:

- Include observations that you have collected and/or analyzed from activities, readings, discussion, and research. Observations can be qualitative (word) and/or quantitative (numbers).
- Include accurate evidence. This means your evidence is correct.
- Include sufficient evidence. This means you have enough evidence.
- Include appropriate evidence. This means only evidence that supports and relates to the claim.

# REASONING

**What is Reasoning?**

The process of explaining how and why evidence supports your claim using scientific principles.

How to write your reasoning:

- Use a logical chain that shows how the scientific principle and evidence work together to support the claim.
    - Statement A: Explain a scientific principle related to your claim.
        - *The scientific principle states…*
    - Statement B: Explain how and why pieces of evidence relate to the scientific principle.
        - *The evidence shows…*
    - Statement C: Restate your claim.
        - *Therefore...*

**The QUESTION:**

_____

_____

**CLAIM:** When you start your response to the question, state your claim.

_____

_____

**EVIDENCE:** Support the claim with accurate, sufficient, and appropriate evidence. Use the chart below to state your evidence and explain what the evidence means.

| | **My EVIDENCE** | **My INTERPRETATIONS** |
|---|---|---|
| | Support your claim with accurate evidence from your investigations, readings, discussions, and research. Be SPECIFIC and RELATE DIRECTLY to your CLAIM! | Explain what your evidence means. How does it relate to the claim? Use words such as: means, tells, shows, and demonstrates. |
| **Evidence #1** | | |
| | | |
| | | |
| | | |
| **Evidence #2** | | |
| | | |
| | | |
| | | |
| **Evidence #3** | | |
| | | |
| | | |
| | | |

**REASONING:** Relate evidence to a scientific principle in order to support the claim.

The scientific principle states _____

_____

The evidence shows_____

_____

Therefore, _____

_____

*Courtesy of Miami Dade County Public Schools, District Office of Mathematics and Science*

***LESSON 3:***

# Scientific Explanation Rubric

**Name: _____ Date: _____/_____/_____**

**Due Date: _____/_____/_____ Period: _____**

| Element | Exemplary | Accomplished | Developing | Beginning |
|---|---|---|---|---|
| | 3 | 2 | 1 | 0 |
| **Claim** | The claim demonstrates a deep understanding of the science topic. | The claim demonstrates an understanding of the science topic. | The claim is inaccurate/ or implausible. | No claim is provided. |
| **Evidence** | All evidence used to support the claim is accurate, sufficient, and appropriate. | Most evidence used to support the claim is accurate, sufficient, and appropriate. | Some evidence used to support the claim is accurate, sufficient, and appropriate. | No evidence is provided. |
| **Reasoning** | Thoroughly relates evidence to a scientific principle in order to support the claim; reasoning is logical, complete, and accurate. | Somewhat relates evidence to a scientific principle in order to support the claim; reasoning is mostly logical, complete, and accurate. | Reasoning is illogical, incomplete, or inaccurate. | No reasoning is given. |
| **Writing Quality and Clarity** | • Writing uses clear, concise, and expressive language.<br>• Writing accurately includes scientific terms and vocabulary. | • Writing uses clear and understandable language.<br>• Writing accurately includes scientific terms and vocabulary. | • Writing uses clear and understandable language.<br>• Writing uses conventional terminology and vocabulary. | • Writing does not use clear and understandable language.<br>• Writing uses conventional terminology and vocabulary. |

| **Rubric Total** | | **Grammar & Spelling** Errors in grammar and spelling will result in a one point deduction. | | ***Overall Total*** | | **Mastery Score** |
|---|---|---|---|---|---|---|
| | — | | = | | → | |

*Courtesy of Miami Dade County Public Schools, District Office of Mathematics and Science*

# OGALLALA AQUIFER


**SOURCE: http://www.npwd.org/Ogallala.htm**

## Interesting Statistics of the Ogallala Aquifer and High Plains Region

1. It is the largest groundwater system in North America.[2]
2. Its 3.3 billion acre feet* of fresh water would fill Lake Huron with enough water remaining to fill one-fifth of Lake Ontario.[1]
3. If pumped out over the United States, the aquifer would cover all 50 states with one and ½ feet of water.[1]
4. If completely drained, it would take more than 6,000 years to refill.[2]
5. Over 170,000 wells pump from the aquifer, one for every square mile.[1]
6. Over 50,000 of these wells are in Northwest Texas.[2]
7. More than 90% of the water pumped is used to irrigate crops, and withdrawals equal 30% of the total groundwater used for irrigation in the U.S.[2]
8. From 1940's to 1980, the aquifer's average water level declined nearly 10 ft. a year.[2]
9. The aquifer is directly responsible for $20 billion a year in food and fiber production.[2]
10. Texas can produce 2 million more bales of cotton a year because of the aquifer.[2]
11. The Texas High Plains accounts for 34% of the state's total cropland and 69% of the total irrigated cropland.[3]
12. Cotton, wheat, and grain sorghum are the most significant Texas crops grown in the region.[3]
13. The aquifer covers 35,000 square miles in Texas (11% of state's lands).[3]
14. Mean precipitation range of 14-22 inches for Texas High Plains.[3]
15. Average saturated thickness in the Texas region of 112 ft with a range of 3-500 ft.[3]

* An acre foot of groundwater is enough to cover an acre of land with one foot of water (~326,000 gallons).[1]

[1] EPA Journal (Lewis)

[2] National Geographic (Zwingle)

[3] Groundwater Exploitation in the High Plains (Urban)

## SOURCE

http://www.ce.utexas.edu/prof/maidment/grad/romanek/wtrproject/stats.htm

## Extension Activity to model a student product demonstrating AQUIFERS

*Adopted from the Groundwater Foundation website:*
*http://www.groundwater.org/kc/activity2.html*

The northeastern aquifer area is based on Appalachian development, erosion, and glacial geology. The purpose of this section is to understand how water moves through soils and is sequestered as an aquifer.
http://upload.wikimedia.org/wikipedia/commons/thumb/0/04/Aquifer_en.svg/360px-Aquifer_en.svg.png

**VOCABULARY:**

Infiltration- Flow of water from the land surface into the soil.
Water Table- The top of an unconfined aquifer; indicates the level below which soil and rock are saturated with water.
Unconfined Aquifer- An aquifer in which the water table is the upper boundary of the aquifer.
Confined Aquifer- Where the groundwater is bounded between layers of impermeable substances like clay or dense rock.
Porosity- The capacity of rock or soil to hold water.
Permeability- The rate at which water moves through rocks or soil.
Recharge- When rainwater seeps into the ground and is added to the aquifer.
Discharge- An outflow of water from a groundwater aquifer. The opposite of recharge.
Groundwater- Water found in the spaces between soil particles and cracks in rocks underground.
Hydraulic Conductivity- the ease with which water can move through pore spaces or Fractures
LINK TO MORE VOCABULARY: HTTP://WWW.GROUNDWATER.ORG/GI/GWGLOSSARY.HTML

**ACTIVITIES - Aquifer in a Cup**

**Objective:** Groundwater is water that is found underground in the spaces and cracks between soil, sand and gravel. Often hidden from view, this activity will illustrate what ground water looks like and some basic groundwater vocabulary.

Materials Needed

- 2 clear cups
- Sand, gravel and aquarium rock (potting soil can be substituted for sand, gravel, and aquarium rock. The soil will float, but zone of aeration, saturation, and an open aquifer can still be seen).
- Pitcher of water

**Procedure**

1. Fill 2 cups with layers of sand and gravel to about 3/4 from the top of each cup. Remember that in nature, aquifers consist of layers of sand, gravel and rock.
2. In one of the cups, pour water slowly into it. Watch how the water fills the spaces between the particles of sand and gravel. Does the water appear to move faster through the sand or faster through the gravel? Why?

3. Now continue to fill this cup with water to the top (above the top of the sand and gravel). Water that is located above ground, like rivers and lakes, is called surface water. Water below the ground's surface is called groundwater.
4. In the second cup, slowly pour water into the cup until the water line is about one inch below the top of the sand/gravel. Look closely at this line created by the water. This line is called the water table. Water below the water table is called the saturation zone.
5. Now pretend that your pitcher of water is a large rain cloud and pour some more water into your second aquifer until the water table is about one half inch below the surface of the gravel. Your groundwater supply has just been recharged.
This is what happens when it rains or snows and water infiltrates (or sinks) into the ground.

**Optional Extensions**

1. Use liquid food coloring or powdered drink mix to represent a source of groundwater contamination. Sprinkle or pour the contamination on the surface of the gravel. Sprinkle water (to represent rain) on top of the gravel and contaminant.
Observe and discuss what happens.

**Conclusion**

We have learned that groundwater is water that is found underground in the cracks and spaces in soil, sand and gravel. We have learned that groundwater is stored in--and moves through--the layers of sand and gravel. This geologic formation of sand and gravel which stores groundwater is called an aquifer.
Aquifers get more water when they are recharged by rain and snow.
Activity Source: The Groundwater Gazette, published by The Groundwater Foundation.
http://www.groundwater.org/kc/activity2.html

**Awesome Aquifers**

**Objective**

To create a working model aquifer, learn about groundwater, increasing one's understanding of groundwater and related concepts.

**Materials**

The following is a list of suggested materials that can be used to build the aquifer. Teams may find other materials they wish to use or other ways to use materials than what is suggested.

- A transparent container (one per team): to build the aquifer in. This could be a jar, 2-liter soda bottle, small aquarium, display box, plastic storage container, etc.
- Sand, gravel, soil, modeling clay/plumbers putty, sponges: represent geological strata
- Plastic syringe or lotion pump: used as a well (pumping or injection)
- Aquarium airline tubing: can be used as part of a well
- Nylon netting, hosiery, coffee filter, or window screen: works as a well screen
- Rubber bands, plumber's putty, or electrical tape: used in various ways to hold parts together (e.g. well screen) Spray bottle: used to demonstrate rain
- Liquid food coloring and/or powered drink mix: represents contamination
- Film canister: can be used as an underground storage tank

**Procedure**
Students will need some initial groundwater knowledge prior to this activity. This activity is best when students have already been introduced to groundwater and related concepts.
Discuss the concepts included in list provided and discuss related topics such as possible sources of groundwater contamination and possible prevention or reduction methods.
Divide the students into teams of 2 or 3. Distribute copies of the Awesome Aquifer Concept list to the students as a guide for their construction and presentation.

**Activity Steps**
1. Design and build a working model aquifer (allow 30-45 minutes)
2. Allow students enough time to discuss in their team how they will construct their model. Give the students ample time to construct a working aquifer with materials such as those listed above and make sure they have had time to prepare a short presentation with their model.
3. Each team of students will present their model to the other teams, demonstrating and explaining concepts included in their model (10 minutes per team, use a timer.)
4. After each team of students has completed its demonstration have students discuss what they learned.
5. Discuss real world situations (drought, contamination…) that may affect groundwater supplies and discuss how communities and individuals might deal with these situations.
Activity Source: Created by The Groundwater Foundation; modified from the Science Olympiad approved event, Awesome Aquifers.

**HOMEWORK**
Go to: http://www.youtube.com/watch?v=uQRvN6MUajE
This EXCELLENT video will give you an overview of what groundwater is and how it relates to human interactions!
Answer these questions after viewing the video:
1. How does an aquifer (groundwater) get filled (recharged)?
2. How does water get cleaned before it goes to the aquifer?
3. Where do homes with well's get there drinking water?
4. How does tar and cement keep groundwater from being recharged?
5. List three pollutants that are seeping into the groundwater in the video.
6. List two ways to prevent groundwater/aquifer contamination.
7. What are some ways to conserve water?
8. What can you do to help keep ground water recharged and clean?

## Assessments

**Formative Assessment:** The comprehension questions/readiness questions and reflection questions can be used as formative assessment (for questions, see the Readiness questions section).

Comprehension and readiness questions will indicate whether the students understand the problem and the problem context, and reflection questions are meant to elicit students' thinking as they are working through the problem.

The readiness questions are asked of students after they read the first client letter (see Reading Passage 1). The teacher can ask the class to respond to these questions and ensure understanding before students begin working with the data.

The reflection questions are asked by the teacher as students are working in their groups on parts 1 and 2 of the MEA. These questions can reveal any misunderstanding or issues that students have as well as guide them to think about what they are doing.

**Feedback to Students:** Students will get feedback from the teacher about their performance or understanding during the lesson.

The readiness questions will initiate discussions and brainstorming in collaborative learning groups to clarify questions about what is expected of them.

They have an opportunity to use this feedback to improve their performance as they modify their models and design for better performance of the product throughout the activity.

**Summative Assessment:**

Summative assessment will include criteria from Collaborative Learning Group Rubric and a final technical report written by each group about their product design, performance, and specifications.

# CER Writing Rubric

| Component | Level | | |
|---|---|---|---|
| | 0 | 1 | 2 |
| ***Claim*** - A conclusion that answers the original question. | Does not make a claim, or makes an inaccurate claim. | Makes an accurate but incomplete claim. | Makes an accurate and complete claim. |
| ***Evidence*** – Scientific data that supports the claim. The data needs to be appropriate and sufficient to support the claim. | Does not provide evidence, or only provides inappropriate evidence (evidence that does not support the claim). | Provides appropriate but insufficient evidence to support claim. May include some inappropriate evidence. | Provides appropriate and sufficient evidence to support claim. |
| ***Reasoning*** – A justification that links the claim and evidence. It shows why the data count as evidence by using appropriate and sufficient scientific principles. | Does not provide reasoning, or only provides reasoning that does not link evidence to claim | Provides reasoning that links the claim and evidence. Repeats the evidence and/or includes some – but not sufficient – scientific principles. | Provides reasoning that links evidence to claim. Includes appropriate and sufficient scientific principles. |

**Department of Mathematics and Science**

*Courtesy of NSTA*

*Courtesy of Miami Dade County Public Schools, District Office of Mathematics and Science*

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