Virginia View Curriculum

Lesson Plan	Virginia's Water Resources: Aquifers
Grade Level	High School, Earth Science
Applicable Virginia SOL	ES 9 (c, d, e)
Summary	Students will learn about aquifers, aquifers in Virginia, and the relationship between geology and aquifer characteristics.
Classroom Materials	This lesson can be completed with or without computers with internet access. To use without computer access, print the materials and handouts listed under "Teacher Preparation."
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Teacher Guide

Applicable Virginia SOL:

ES.9 The student will investigate and understand how freshwater resources are influenced by geologic processes and the activities of humans. Key concepts include:
c) identification of groundwater zones including the water table, zone of saturation, and zone of aeration;
d) identification of other sources of fresh water including rivers, springs, and aquifers, with references to the hydrologic cycle;
e) dependence on freshwater resources and the effects of human usage on water quality
f) identification of the major watershed systems in Virginia including the Chesapeake Bay and its tributaries

Working definitions:

Aquifer – A subsurface reservoir that is saturated with water.

Confined aquifer – an aquifer that is trapped above and below by impermeable or poorly permeable rock, which may be pressurized

Teacher Preparation:

Review sources of fresh water and drinking water used in your area.

Review the student worksheet.

Print out (one per group of students) or save links (if using a classroom with computers) for:

- The map "Aquifers in and Around Virginia" from the Digital Atlas of Virginia, which can be accessed as:
  - PDF (4.24 MB) à http://gep.frec.vt.edu/Digital_Atlas_PDFs/aquifers.pdf
  - Interactive Web Mapper - http://arc.gis.vt.edu/Aquifers/ (note: May be slow to load, please be patient)
  - Data service to be used in ArcGIS (Add GIS Server http://arc.gis.vt.edu/arcgis/services , select the "VAView" folder, add the Aquifers data service).
  - Data service to be used in ArcGIS Explorer or ArcGIS Explorer online http://arc.gis.vt.edu/ArcGIS/rest/services/VAView/Aquifers/MapServer

- Handouts for each of the six rock types listed on http://water.usgs.gov/ogw/aquiferbasics/index.html (make sure the maps are included and visible)
- Handouts on aquifer basics on http://ga.water.usgs.gov/edu/earthgwaquifer.htm
- For each student, a student worksheet

Consider dividing the classroom into six groups – one for each aquifer type listed in the lesson. Have students research their group's aquifer type, then collaborate to fill in the "aquifer types" chart.

Student Worksheet: Virginia's Aquifers

Name: _____

Water sources

1. What are the sources of fresh water for your county (city)?
   Name at least four:
   _____ _____ _____ _____

2. How does your county (city) use this water?
   Give six examples: _____ _____ _____ _____
   _____ _____ _____

3. Which uses of this water can affect water quality? How?

4. Where does your drinking water come from? _____

Aquifers: Refer to the map, "Aquifers in and Around Virginia" from Virginia View.

1. Are the aquifers pictured on the Virginia View Aquifer Map the only aquifers in Virginia?

2. Do you think there is a relationship between the physiographic provinces of Virginia and the surface aquifers? What is your reasoning?

3. What is an aquifer?

Aquifer Basics: Use the Aquifers handout or go to http://ga.water.usgs.gov/edu/earthgwaquifer.html

1. The top of the saturated zone of ground water is called the _____
2. Water movement is highly dependent on _____
3. What range of movement is quoted in this article (speed)

4. Describe how water moves through an aquifer once it enters the aquifer.

5. How is an aquifer "recharged"?
6. What conditions are necessary for an artesian well?

Look at the map "Aquifers in and Around Virginia"

1. How many aquifers are there in Virginia? _____
2. Which aquifer(s) is(are) located in your county or city? _____

Aquifer Geology: Use the aquifer type handouts, or on the Internet, go to Aquifer Basics **http://water.usgs.gov/ogw/aquiferbasics/index.html** and fill out the following chart.

Aquifer Type	Where the aquifer type occurs (general description)	Characteristics of this aquifer type (give at least two)	Is this aquifer type a good source of water?	Is it found in Virginia?	If in VA, name the specific aquifer where it occurs. (use Virginia map)

Resources

Digital Atlas of Virginia: http://virginiaview.cnre.vt.edu/digital_atlas.html

A map-based resource designed for Virginia teachers. The Digital Atlas contains many different maps pertinent to Virginia in several accessible formats.

Ground Water in Virginia: http://www.virginiaplaces.org/watersheds/groundwater.html

A nice overview of aquifers and ground water, specific to Virginia geology.

Principal Aquifers in the United States: http://nationalatlas.gov/mld/aquifrp.html

Digital geographic data available in several different formats.

Aquifer Basics from USGS: http://water.usgs.gov/ogw/aquiferbasics/index.html

Contains detailed geologic information on the principal aquifers in the U.S.