Nick Grabemeyer - MiTEP Cohort 3
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Groundwater in Kalamazoo

Introduction – The purpose of this lesson is for students to discover where and how they get what is arguably their most important resource – water. The lesson focuses on the Kalamazoo area ground water supply but could easily be adapted to fit any local community in Michigan.

Time Required: 3-5 class periods

Grade Level – 9^{th}-12^{th} grade

Objectives –

1. Students will construct a scale model of the ground water in their community.
2. Students will be able to describe the source of drinking water in their community.
3. Students will be able to discuss the importance of groundwater in their community.

MI HSCE Benchmarks –

1. **E4.1B** Explain the features and processes of groundwater systems and how the sustainability of North American aquifers has changed in recent history (e.g., the past 100 years) qualitatively using the concepts of recharge, residence time, inputs, and outputs.
2. **E4.1C** Explain how water quality in both groundwater and surface systems is impacted by land use decisions.

Engage – Ask Students to describe where their water comes from. Have students draw a picture that illustrates the source of their water. A short, 5-7 line type one (John Collins) writing should accompany their picture. Have students share their drawings and writings with each other.

Explore - Students will construct a scale model of the ground water using data from a local well. Well data sheets for Michigan wells can be downloaded from the DEQ Wellogic Website. Well Data sheets provide information about well depth, static water level, and formation descriptions. Wells with simple or complex formations can be selected depending on the level of students in your class. See student handout for details on model construction.

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Explain – Provide students with reading about ground water in the great lakes. After reading, discuss with the class the structure and origin of surface aquifers found over much of Lower Michigan including Kalamazoo. Introduce students to the Protect Your Water Website from the City of Kalamazoo. Have students explore the website and create a worksheet that goes with the website. Have the students exchange worksheets with each other and complete them.

Elaborate – Schedule guest speaker from Kalamazoo Municipal Water Department or arrange for a field trip to the Water Department.

Evaluate – Have students reflect on what they've learned about groundwater in Kalamazoo. Ask them again to construct an illustration of where their water comes from. To go with this illustration ask them to complete a type 3 (John Collins) writing about the groundwater supply in Kalamazoo. Provide students with a list of groundwater associated vocabulary words they should try to use in their writing.

Accommodations – Students with learning disabilities may benefit from the following accommodations:

1. Reducing the amount of writing required for the engagement and evaluate phases.
2. Provide well data sheets with important information highlighted making it easier to find.
3. Provide a sheet with step by step instructions for the calculations.
4. Provide opportunity for students to participate in read aloud during the groundwater reading in the explain phase.

Acknowledgments – Dr. Stephen Mattox, GVSU, for the idea to use fluorescent bulb tube guards as a cheap modeling material.

Resources –

DEQ Wellogic System Website. Accessed 7-31-12. Available online at: https://secure1.state.mi.us/WELLOGIC/Login.aspx.

Five Type of Writing: A practical approach. Collins Education Associates Website. Accessed 7-31-12. Available online at: http://www.collinseducationassociates.com/five_types_of_writing.htm.

Grannemann, N.G., Hunt R.J., Nicholas J.R., Reilly T.E. and Winter T.C. The Importance of Groundwater in the Great Lakes Region. Water-Resources Investigations Report 00-4008. Groundwater Mapping Project Website. Accessed 7-31-12. Available online at: http://gwmap.rsgis.msu.edu/.

Protect Your Water Website. Accessed 7-31-12. Available online at: http://www.kalamazoocity.org/portal/water.php.

Tarbuck, Edward J., and Frederick K. Lutgens. Prentice Hall Earth Science. Upper Saddle River: Pearson Education, 2009.

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Constructing a Scale Model of a Kalamazoo County Groundwater– Student Handout

Group Members:

Introduction: In this activity you will work in a small group of between 2-3 people and construct a scale model of the ground water right here in Kalamazoo.

Background Information: Use your earth science textbooks and describe the following terms.

1. Aquifer –
2. Infiltration –
3. Permeability –
4. Porosity -

Materials:

1 4 ft fluorescent bulb tube guard
Gravel (fine, medium, and coarse)
Sand
Clay (substitute)
Well Data Sheet from Local Well
2 Plastic Caps (for tube guard)
Funnel
Wet Erase Markers (various colors)
Stop Watch

Procedure:

1. Obtain a well data sheet from the teacher. Examine it carefully with your team members. Record the following Information in the spaces below:
   - **a.** Well Location_____
   - **b.** Well Use: _____
   - **c.** Well Depth _____
   - **d.** Formation Description:

   - **e.** Static Water Level:

2. Determine an appropriate scale for your model. To do this take your well depth (in feet) and divide it by 48 (the length of your model in inches). This will tell you how many feet one inch of your model represents. For example if the well depth is 180 feet then: 180/48 = 3.75. So 1inch is equal to 3.75 ft. Record your scale below:
   - **a.** 1 inch of our model is equal to _____ Feet

3. To determine the thickness of the separate layers found in the formation. Divide the thickness in feet from the description in your well data sheet by the scale you determined above. For example if the thickness of the first layer was 90 feet then: 90/3.75 = 24. So the first layer of your model would be 24 inches thick. Record your calculations below:

4. Starting at the bottom most layer, use the funnel and add the appropriate amount of each material into your model. Make sure the bottom of your model is capped so material doesn't fall out. Use wet-erase markers to label the various layers on the outside of your model.

5. Use the same procedure you following in step 3 to determine where the static water level should be in your model. Record the calculation below. Mark this location on your model with a wet erase marker.
    a. Static Water Level Calculation:

6. Obtain 500 mL of water that has been dyed with food coloring. (coloring is to enhance visibility)

7. Using the funnel carefully poor the water down the tube. Using a stop watch record the amount of time it takes the water to reach the static water level, travel thru the various formations, and reach the final well depth. Create a data table in the space below to record your information.

8. Have your teacher examine your model. Describe your groundwater model to the teacher. If your teacher approves of your model have him/her sign here:
    a. _____(teacher signature)

Analysis:

1. Discuss with your team the strengths and weaknesses of your groundwater model. Record your discussion below.

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2. Compare your model to others in the class. What similarities and differences do you see?

3. Propose an explanation(s) for the similarities and differences you see.

4. The water infiltrating through your model did not move at the same rate through the various materials. Propose an explanation for this.

Clean-up:

1. Remove cap from bottom of model carefully over a bucket or sink and drain water from model.
2. Remove formation materials and return to the appropriate containers. Be careful not to mix the layers.
3. With a wet cloth wipe the outside of the tube guard down to remove any marks left by the wet-erase markers.
4. Rinse out the tube guards and PVC pipe with water and return to designated area.
5. Return all other materials to their designated areas.
6. Wipe down your lab table.
7. Get your teacher to sign below verifying clean-up*:
    a. _____ (teacher signature)

**** REMEMBER NO SIGNATURE=NO GRADE!!!***