Geoscape Ottawa-Gatineau

Grade 9 - 11 Lesson Plans to accompany the Geoscape Ottawa-Gatineau poster and website

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Theme 7: GROUNDWATER : VITAL BUT VULNERABLE

OVERVIEW

- Students investigate the components of groundwater as an integral part of the hydrologic cycle.
- Students construct Hele-Shaw cells to study the behaviour of aquifers.
- Students analyze water quality for its chemical and physical properties.
- Students assess and appreciate the factors that are responsible for quality groundwater.

DURATION 200 minutes (2 periods)

ACTIVITY

1. Students complete a labelled diagram of the hydrologic cycle with an emphasis on the groundwater portion. In this area, ~45% of precipitation is lost to evapo-transpiration, ~45% runs off the surface into streams, and only about 10% becomes groundwater.

2. Refer to the Urban Geology of the National Capital Area web site, hydrogeology section http://gsc.nrcan.gc.ca/urbgeo/natcap/hydrogeology_e.php .
   - Which are the good aquifers in the region?
   - Which are undesirable aquifers and why?
   - What is the significance, to the hydrologic cycle and groundwater supply, of the thick cover of marine (Leda) clay over much of the area?

3. Students construct Hele-Shaw cells to study the behaviour of confined and unconfined aquifers. Instructions can be found on the web. Or the teacher constructs it in advance. One example is attached here. Student Worksheet 1 is completed.

4. Students complete a comparative analysis of the chemical and physical properties of water samples from different sources. Student Worksheet 2 is completed.

5. As a notebook summary, students list the factors that contribute to a good quality source of groundwater.

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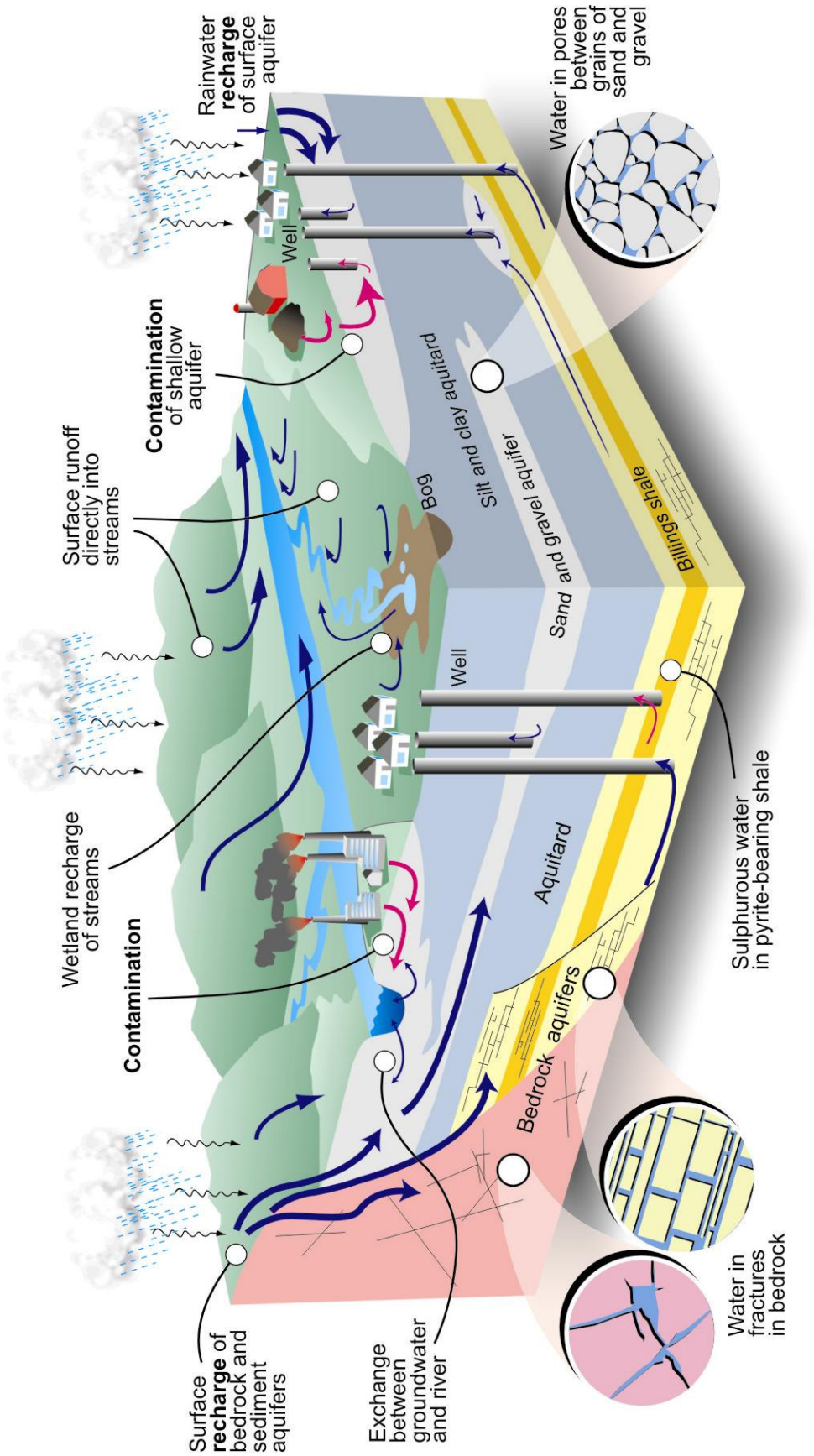

Rainwater recharge of surface aquifer
Water in pores between grains of sand and gravel
Well
Contamination of shallow aquifer
Surface runoff directly into streams
Bog
Silt and clay aquitard
Sand and gravel aquifer
Billings shale
Wetland recharge of streams
Well
Contamination
Aquitard
Sulphurous water in pyrite-bearing shale
Bedrock aquifers
Surface recharge of bedrock and sediment aquifers
Exchange between groundwater and river
Water in fractures in bedrock

Student worksheet #1 : HELE-SHAW CELLS

Description: Students will create a model of an aquifer and show how pollution can contaminate an aquifer.

Materials

- Large glass bowl or small aquarium
- Sand
- Plasticine or modelling clay
- Water
- Red food dye
- Drinking straw or metal rod
- Clear glass tube

1. Assemble the model

   a) Fill half full of sand. Flatten.

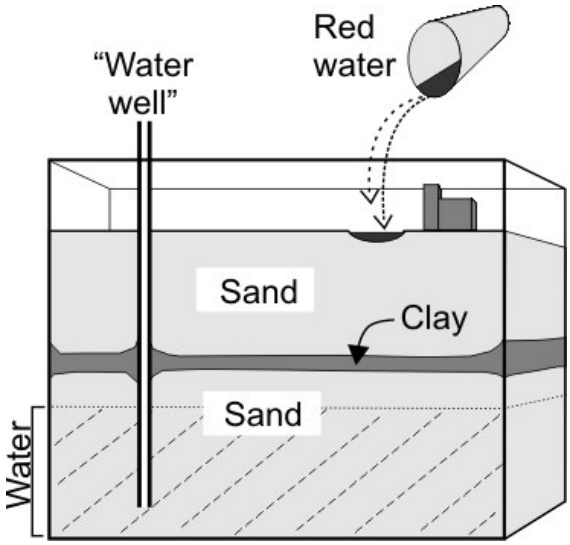
   b) Add water to 1-2 cm below top of sand.

   c) Place a flat sheet of plasticine or modelling clay on top of the sand, carefully sealing the edges to the glass.

   d) Insert a clear glass tube through the aquitard and into the lower aquifer. Carefully make a seal. This is a water well.

   e) Carefully add another layer of sand, taking care not to move the tube or break the seals.

   f) Set a toy building or block on the surface near one end to represent the source of contamination.



2. Define aquifer and aquitard.

3. Identify the aquifer and aquitard layers and the water table on the diagram.

4. In the 'real world' that is represented by the model, rain falling on the surface would not reach the lower sand layer. Why? How would water have saturated the lower sand layer?

5. Slowly pour red water on the surface at the contamination site and observe. What happened to the upper sand layer . What happened to the lower sand layer ?

6. Perhaps the 'aquitard' is not continuous or is broken by fractures, old wells, etc. Pierce the aquitard layer with a rod in a few places and observe. What happened in the lower sand layer ?

7. The impact of pollution may be felt far away from the contamination source. List some possible sources of contamination.

Student worksheet #2 : **WATER ANALYSIS**

Reference W. Andrews. Environmental Pollution p.22

1. Water samples should be collected from as many as possible of the following sources. Temperature should be tested at time of collection as it will change quickly.

   A. Municipal Tap Water – i.e. City of Ottawa
   B. Community Well Water – i.e. Richmond
   C. Well Water 1. Iron known to be present
      2. Sulfur known to be present
      3. "Hard" water
      4. "Good" well water
   D. River Water 1. Ottawa River or major tributary
      2. small tributary/stream
   E. Rain Water - fresh
   F. Swamp or Wetlands Water

2. Using a water test kit from Hach/Lamotte, Fischer Scientific or Wards Scientific, test the water samples for the physical and chemical properties listed in the spreadsheet.

3. Rank the quality of water for each of the samples for each of the properties. Rank the overall quality of all of the samples.

Property	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	**Ranking**
Temperature								
Dissolved O_2								
pH								
Alkalinity								
Hardness								
Colour								
Nitrogen								
Phosphorous								
Ranking								