Awesome Aquifers

Rules Summary:

- Students will answer questions about groundwater, and construct and present a model of an aquifer.
- Maximum team size: two students
- Two written tests (10 minutes each)
    - Tests given before start of event (time: TBD)
    - Test 1 – multiple choice, vocabulary and concepts, more focus on vocabulary. Each question will be labeled with the number of points it is worth. (10 minutes)
    - Test 2 – use information from a diagrams to solve equations, make drawings or answer conceptual questions. (10 minutes)
    - Students should arrive a few minutes early and have their own pencils
- Build a model in a small container (less than three liters). The model will demonstrate knowledge of aquifer concepts shared with the students just prior to the build. Concepts include, but are not limited to: surface water – groundwater connection, aquifer draw down, contaminate transport, combinations of the above…
- Presentation to a judge, students will present as much information as they can. Judges will only ask questions if students talk less than 10 minutes.
- First tie-break will be the highest score on the presentation. Subsequent tie-breaks will be pre-determined and labeled on the written test.

Test 2 is based on concepts rather than vocabulary. Students should be able to read and infer information from a contour map and well diagram. An example of a well diagram is attached.

Students should be familiar with Darcy's Law. Q=KiA.

Q is the total flow through the aquifer usually in cubic feet per second or cubic foot per day
K is a property of the aquifer and will be given if needed
i is the hydraulic gradient through the aquifer. It is frequently obtained from a well diagram
A is the cross sectional area of the flow

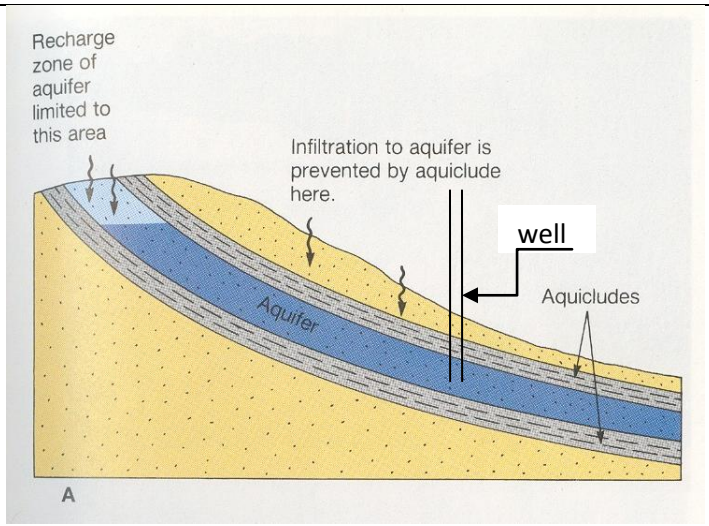
I don't envision students solving this equation but would like for them to understand what happens to the total flow if everything is kept the same but the area increases or the hydraulic gradient is cut in half.

Testing Tip: Multiple choice questions in test 2 will likely have more than one correct answer. Students will be informed if the question has more than one correct response. Students must identify most (maybe all) of the correct responses for full credit. Minimal partial credit will be assigned on these problems. Students will be informed of how many correct responses are required for full credit.

Example Questions:

Permeability describes…

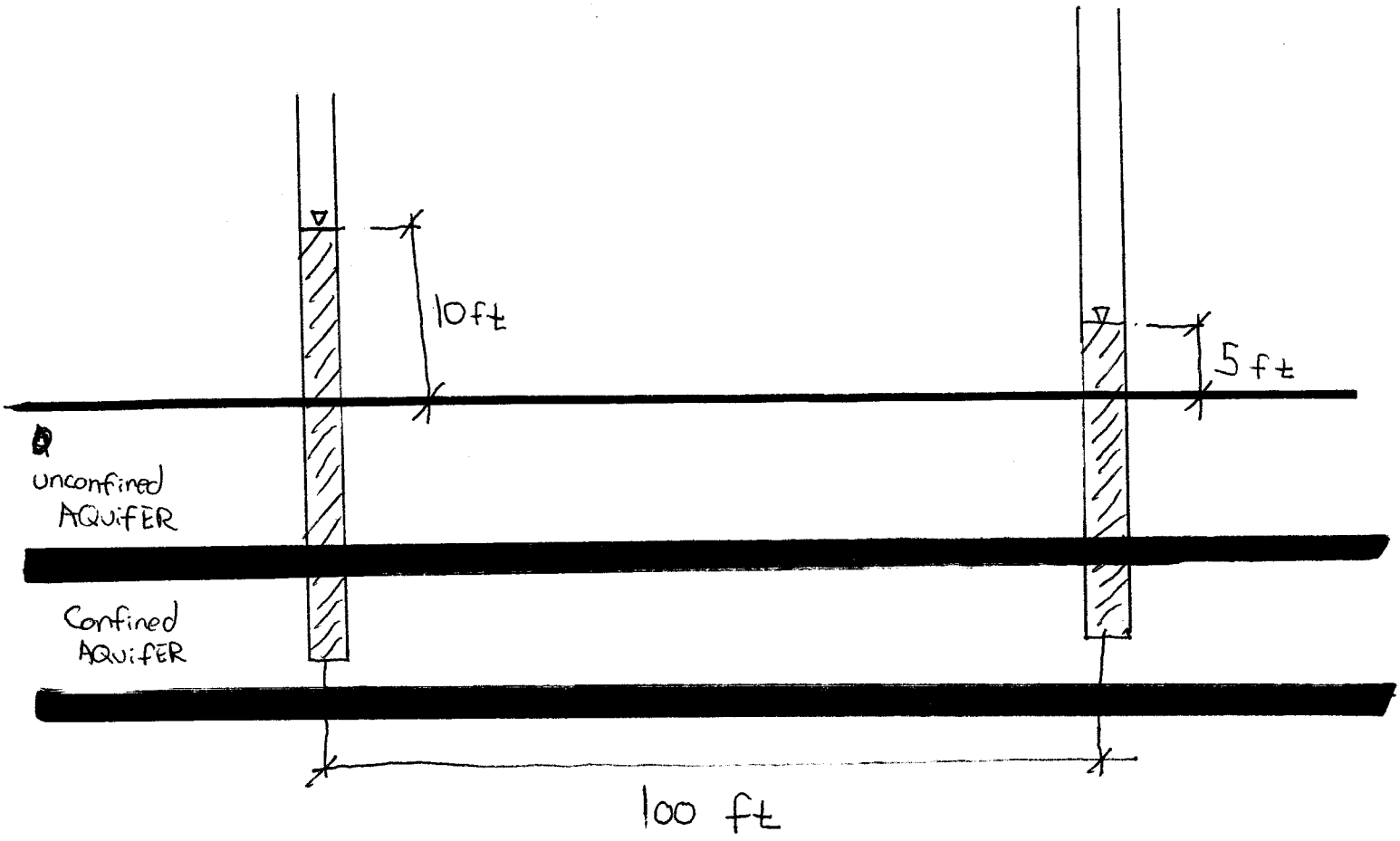
(a) The ability of a material to transmit a fluid
(b) Moisture stuck to particles due to surface tension
(c) The measure of the void space in a material
(d) Volume of water drained from a porous material



Question 2:
How high will the water in the well rise? Indicate by coloring in the well.

Figure courtesy of Montgomery, "Environmental Geology " *fourth edition*

Well diagram



Hydraulic Gradient $i = \frac{10\,ft - 5\,ft}{100\,ft} = 0.05$

What Direction does the water flow?

Official Rules for Competition: Awesome Aquifers

AWESOME AQUIFERS

1. **DESCRIPTION:** Students will construct an aquifer and answer questions about groundwater concepts.

   A TEAM OF UP TO: 2 **APPROXIMATE TIME**: 50 Minutes

2. **EVENT PARAMETERS:** The supervisor will supply score sheets, water, Station 2 resources, and Station 3 building objectives. Students are required to bring any materials needed to assemble an aquifer on-site. The entire aquifer is to be housed in one transparent container not exceeding a total volume of 3 liters. This container can be cut or punctured in advance but must be brought to the competition empty. Electric pumps/tools and commercial flow models are not allowed. Students cannot bring notes, texts, or references. Students are responsible for taking and/or properly disposing of all materials used in assembling their aquifer. An extended list of suggested materials and possible concepts are available at http://www.groundwater.org/pe/so_aa.html and may include but not limited to material such as:

   a) Sand and gravel (such as pea-sized or aquarium gravel)
   b) Modeling clay or plumber's putty
   c) Materials for wells and pumps, such as soap bottle pumps or aquarium tubing and plastic syringes. No electric or commercial pumps permitted.
   d) Well screening materials, such as nylon hose, cotton, coffee filters, etc.
   e) Sponge
   f) Aluminum foil and/or plastic wrap or sheeting
   g) Empty 35 mm plastic film canisters or equivalent
   h) Material to represent contaminants, such as food coloring or powdered drink mix
   i) Materials that could be used for remediation such as coffee filters, fabric squares, charcoal, etc.
   j) Items useful in creating or demonstrating the aquifer but that will not be part of the aquifer, such as scissors, tacks, tape, containers to hold water and/or contaminants, blank paper, pen or pencil, etc.

3. **THE COMPETITION:** Students will be given 10 minutes to complete each station.

   a) Station 1: Students take a written test on groundwater concepts and vocabulary. Questions can be multiple choice, true/false, fill in the blank, or short answer.
   b) Station 2: Students take a written test utilizing provided resources such as maps, charts, graphs, models, and scientific publications. Questions can be multiple choice, true/false, fill in the blank, or short answer.
   c) Station 3: Students build an aquifer that will explain and demonstrate concepts chosen by the event supervisor. Students may create notes at Station 3 to use at Station 4. Possible concepts include but are not limited to: recharge, discharge, connection between surface and groundwater, water table, porosity, permeability, well location and abandonment, groundwater contamination, remediation, and safe yield from an aquifer. See list of presentation concepts for regional, state, and national tournaments at Awesome Aquifer event page at www.soinc.org.
   d) Station 4: Students use the aquifer built at Station 3 to explain and demonstrate the required concepts to a judge(s). Information may be presented in any way or order students choose and the same demonstration may be used to explain more than one concept. Judge(s) may ask clarifying questions but only if a team has finished its demonstration and there is time remaining.

4. **SCORING:** Highest score wins. Station 1-25%, Station 2-25%, and Station 4-50%. First tiebreaker: highest score at station 4. Second tiebreaker: highest score on pre-selected questions at station 1 and 2. Answers must include units where appropriate.

Recommended Resources: All reference and training resources including the **Awesome Aquifer DVD** are available on the Official Science Olympiad Store or Website at www.soinc.org

THIS EVENT IS SPONSORED BY THE GROUNDWATER FOUNDATION (www.groundwater.org/pe/so_aa.html)