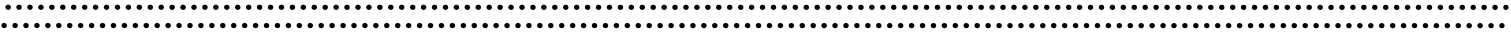


**Science Olympiad  
Hydrogeology**

Raw Score: \_\_\_\_\_ Rank: \_\_\_\_\_

Name(s): \_\_\_\_\_

School Name: \_\_\_\_\_ State: \_\_\_\_\_



**Point Totals**

	Possible	Total
Part 1: Groundwater Concepts and Vocabulary	10	
Part 2: The Hydrogeology Challenge – Static Conditions	10	
Part 3: Contamination Risk and Remediation	20	
Total		
1 <sup>st</sup> Tiebreaker: Highest score on part 3.	.5	
2 <sup>nd</sup> Tiebreaker: Highest score on pre-selected test questions-.01pt per question.	.01	
<b>TOTAL POINTS</b>		



- 6) A LNAPL is a liquid that is \_\_\_\_\_ than water and \_\_\_\_\_ dissolve in water.
- a. More dense, does
  - b. Less dense, does
  - c. More dense, does not
  - d. Less dense, does not
- 7) Which of the following is **not** associated with groundwater depletion?
- a. Dry Well
  - b. Safe Yield
  - c. Salt water intrusion
  - d. Subsidence
- 8) All of the following contaminants are volatile organic compounds **except**
- a. Acetone
  - b. Chloroform
  - c. Methanol
  - d. Radon

Hydrogeology: Water for the World

Part 2: THE HYDROGEOLOGY CHALLENGE – STATIC CONDITIONS

Please submit your answers online for this portion of the event. **It is a good idea to write down your calculated values as you work through the Hydrogeology Challenge just in case you need to refresh the page or have computer issues.**

This section is worth a total of 10 points

---

Directions:

Complete the Hydrogeology Challenge Scenario in static (non-pumping) conditions using wells **F, A and C.** The National Hydrogeology Challenge can be found at:

<http://groundwater.beehere.net/#test/829befce-c3a8-41a9-982a-77026f885846>

When submitting your answers:

Name: [Team members and school]

Location: Nationals 2015

Hydrogeology: Water for the World  
Part 3: CONTAMINATION RISK AND REMEDIATION

There are 20 points possible.

---

The Situation:

The community of *Nationalia* is concerned about the pollution potential of a military base located nearby. Well D was being used as a private drinking water source until the chemical RDX was discovered and the residents could no longer drink the water. The community has hired you to determine how to proceed.

The Facts

The contaminant RDX has been found in well D

Well D and Well A are currently pumping water

- 1) Other than well D, what well(s) are at risk of contamination by the RDX? (1 point)
  
- 2) Using the horizontal velocity calculated in part II, what is the approximate time of travel of the contaminant to the **nearest** at risk well? (1 point)
  - a. Less than one year
  - b. 2 years
  - c. 4 years
  - d. 8 years
  
- 3) Using the horizontal velocity calculated in part II, what is the approximate time of travel of the contaminant to the **farthest** at risk well? (1 point)
  - a. 3 years
  - b. 6 years
  - c. 12 years
  - d. 24 years
  
- 4) What lithological layer was used to determine the flow velocity in part 2 and why? (2 points)

5) Assuming the Hydrogeology Challenge assumptions are correct, name two factors that would influence the flow velocity in this model? (1 point)

6) If the military base discontinues its operations using and storing the chemical RDX will the risk of further pollution in other wells be eliminated, why or why not? (2 points)

Remediation Technique	Definition (1 pt)	In-situ or ex-situ (0.5 pts)	Type (Biological, Physical, Chemical, Thermal, Containment Only, or Other) (0.5 pts)	Applicable to RDX? (yes/no) (0.5 pts)
6. Phytoremediation				
7. Air Stripping				
8. Permeable Reactive Barrier				
9. Thermal Treatment				
10. VEBs				

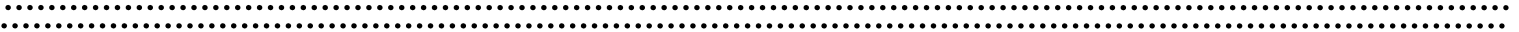
Science Olympiad  
Hydrogeology

# Answer Key

Raw Score: \_\_\_\_\_ Rank: \_\_\_\_\_

Name(s): \_\_\_\_\_

School Name: \_\_\_\_\_ State: \_\_\_\_\_



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<b>TOTAL POINTS</b>		

## Hydrogeology: Water for the World

### Part 1: GROUNDWATER CONCEPTS AND VOCABULARY

There are 10 points possible. Possible points are labeled next to each question.

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- 1) Define a confining layer and name two geologic materials this layer can be made of. (2 points)

A confining layer is a geological layer made up of materials that **water passes through very slowly or not at all**. It can be made of any material that is not unconsolidated such as clay, rock with no fractures in it, siltstone, mudstone ect.

- 2) Explain the difference between a flowing artesian well and a natural spring. (2 points)

Flowing artesian well occurs when a **well is drilled into a confined aquifer** under pressure the **water will rise to the surface and flow from the well without pumping**. A natural spring is the emergence of groundwater at the land surface with **no drilling or digging of a well**.

- 3) Define BMPs in the context of source water protection. (1 point)

BMP = Best management practice → these are voluntary actions taken by land owners, municipalities and communities to protect the water they use as a drinking water source

- 4) Which sand layer will have the greater porosity, one that is composed of round grains or one that is composed of angular grains? (1 point)

Round Grains → The flat edges of angular sand grains have more opportunity to fit together limiting the pore space between the individual sand grains

- 5) Groundwater is an integral part of the water cycle. By what processes does surface water become groundwater?

**Precipitation** falls on the lands surface → **infiltrates** the ground and **percolates** down to the water table where it becomes groundwater.

**Precipitation    Infiltration    Percolation**



- 6) A LNAPL is a liquid that is \_\_\_\_\_ than water and \_\_\_\_\_ dissolve in water.
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Hydrogeology: Water for the World

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Hydrogeology: Water for the World  
Part 3: CONTAMINATION RISK AND REMEDIATION

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A B C

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- c. 12 years
- d. 24 years

- 4) What lithological layer was used to determine the flow velocity in part 2 and why? (2 points)

Coarse sand and gravel because the hydrologic conductivity is the highest below the water table in the well with the highest static elevation

- 5) Assuming the Hydrogeology Challenge assumptions are correct, name two factors that would influence the flow velocity in this model? (1 point)

Turning pumping on or off in different wells, the lithology, the depth to the water table, gradient

- 6) If the military base discontinues its operations using and storing the chemical RDX will the risk of further pollution in other wells be eliminated, why or why not? (2 points)

No – if there is no active cleanup of the preexisting contaminants they still pose a risk to other wells

<b>Remediation Technique</b>	<b>Definition (1 pt)</b>	<b>In-situ or ex-situ (0.5 pts)</b>	<b>Type (Biological, Physical, Chemical, Thermal, Containment Only, or Other) (0.5 pts)</b>	<b>Applicable to RDX? (yes/no) (0.5 pts)</b>
<b>6. Phytoremediation</b>	Uses plants to clean up contaminated environments	In	Biological	Yes
<b>7. Air Stripping</b>	The process of moving air through contaminated groundwater in an aboveground treatment system. Often used with pump and treat method	In/ex	Physical	No
<b>8. Permeable Reactive Barrier</b>	A zone created below ground which the polluted water must flow through to be treated. The reactive materials that make up the zone either trap harmful contaminants or make them less harmful	In	Biological/chemical	No
<b>9. Thermal Treatment</b>	Move or mobilize harmful chemicals in groundwater using heat. The chemicals move through the groundwater towards wells where they are collected and piped to the round surface to be treated using other methods	In	Thermal	No
<b>10. VEBs</b>	Vertical engineered barriers	In	Containment only	yes