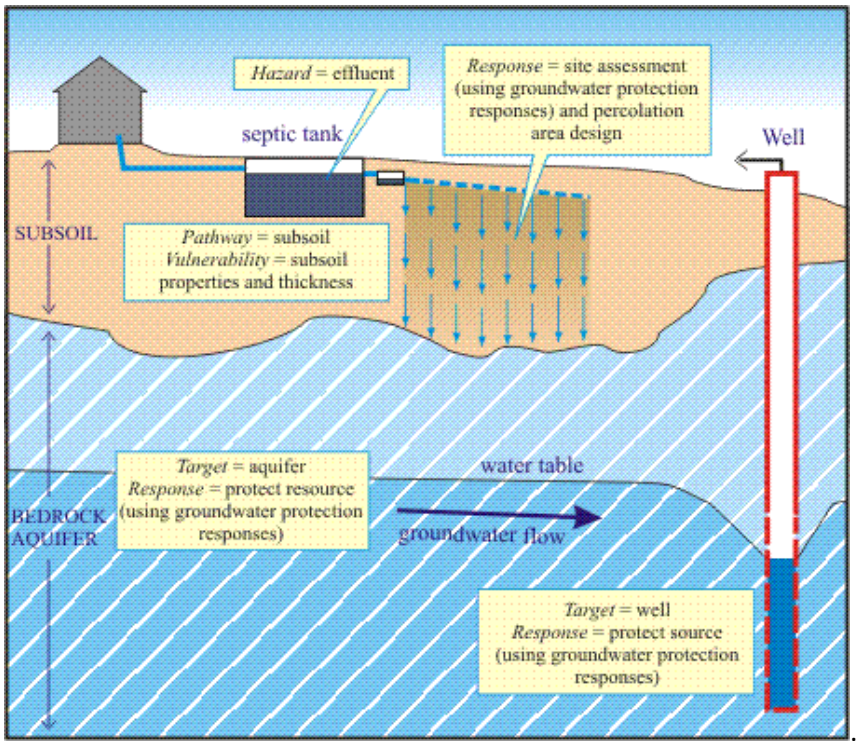
YESS Program – Environmental Engineering

"Where is the chromium?"

Why this lab?

Environmental Engineers evaluate the transport of contaminants in groundwater to protect humans from exposure in drinking water.

Soil interacts with contaminants in various ways, reducing their concentration, in a process called *retardation.*



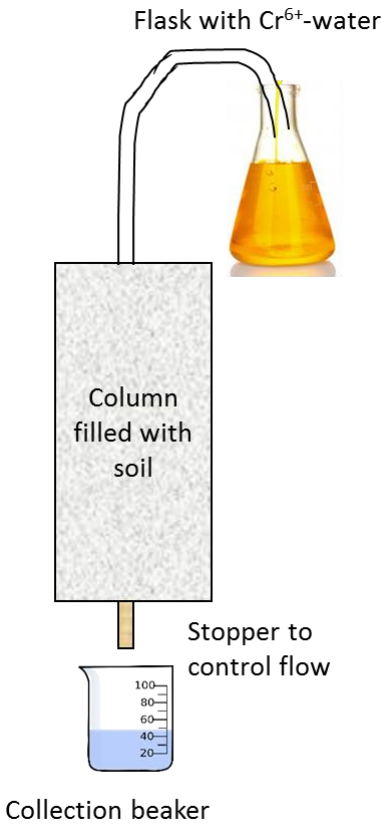
What are the objectives of this lab?

We will utilize hexavalent chromium [Cr] as a model contaminant. This is a human carcinogen, therefore we need to follow ***safety precautions*** when handling the samples.

The objective of the lab is to determine how water with Cr is affected by traveling through a soil column and whether you can drink it at the exit.

What are the rules for potable water?

The U.S. EPA stipulates the National Primary and Secondary Drinking water regulations, see http://water.epa.gov/drink/contaminants/index.cfm for the complete list. The concentration of chromium must be less than 0.1 mg/L.



Experimental Procedure

The experiment has been set up for you, as shown in the figure. Your job is to:

1. Measure Cr in the soil that has been used to fill the column.
2. Measure the Cr concentration in the initial solution in the flak. (Would you like to say flask?)
3. Open the stopper and collect the outflow from the column until you have 50 mL.
4. Measure the Cr concentration in the collected water.
5. Open the column, take out some soil and measure the Cr concentration after the experiment.

Analysis Methods

We will be using two methods, one for the water and one for the soil:

Water: We will apply a colorimetric method, which relies on the development of a bright pink color when Cr reacts with a specific chemical called diphenylcarbazide.

Soil: We will use X-ray Fluorescence analysis. This is an equipment that automatically measures Cr and other elements in the soil. It uses X-rays, so you are NOT allowed to operate it yourself. Your instructor will help you prepare the sample and show you how it works.

Health and Safety

You are working with a toxic and carcinogenic compound (hexavalent chromium), as well as dilute acid (H_2SO_4) and equipment with ionizining radiation (X-rays). You HAVE to follow these rules

1. Wear your lab coat and gloves during the entire experimental procedure.
2. Do not touch your skin with gloves that have come in contact with the samples or the reagents. If you need to, take off the gloves, dispose of them and put on a fresh pair when you are ready to start working again.
3. Wait for instructions, do not attempt to touch things before you know what they are.
4. Do not attempt to use the XRF equipment on your own.

Procedure for Cr measurement in water

1) Transfer 1 mL of water sample into a 50mL volumetric flask and fill up with DI water to 50 mL (watch for the 50mL line). **This corresponds to a 1:50 dilution.**
2) Transfer the solution to an Erlenmeyer flask and take out 2.5 mL of sample using the 5 mL pipette.
3) Add 1.0mL diphenylcarbazide solution and mix.
4) Add 10% H_2SO_4 solution drop by drop until pH reaches 2 $\pm$ 0.5.
5) Bring back to the volumetric flask with a use of a funnel and add DI water to bring the total volume up to 50 mL again.
6) Transfer again to the Erlenmeyer flask and let stand for 5 - 10 min for full color development.
7) Use the 1 or 5 mL pipette to transfer solution to a 1cm absorption cell up to the line and measure absorbance at 540 nm. Use DI water as blank.

5 standards have been prepared for you. While you are waiting for color development, measure the absorbance of each standard and plot the data in the graph below. This is your calibration curve.

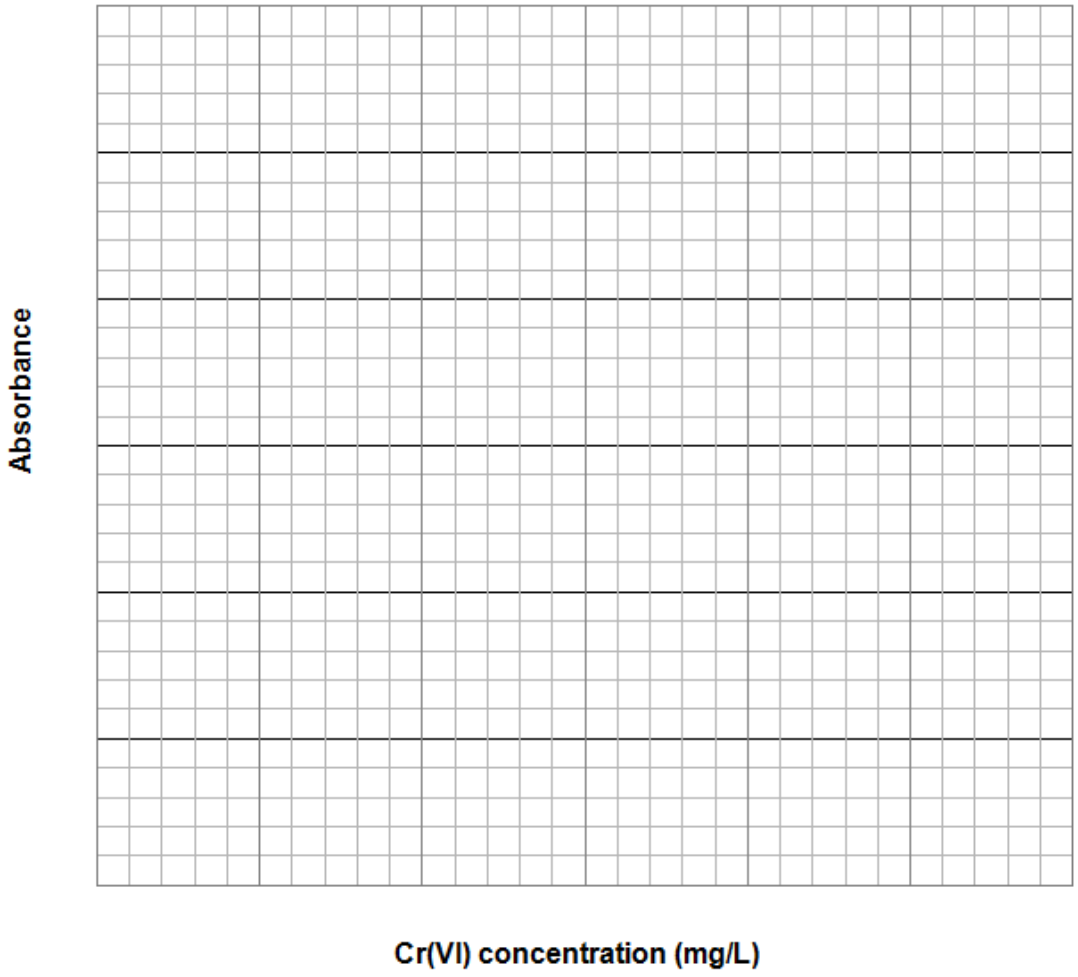
Cr(VI) (mg/L)	Absorbance
0.05	
0.1	
0.2	
0.5	
1	

The absorbance of the initial Cr solution is _____

Based on this data, the Cr concentration measured is _____ and multiplying with 50 to account for dilution the initial concentration is _____

The absorbance of the column effluent is _____

Based on this data, the Cr concentration measured is _____ and multiplying with 50 to account for dilution, the Cr concentration of the column effluent is _____



Soil Cr measurement

(Put your soil samples into the XRF – cell and cover with Window Film)

BEFORE _____

AFTER _____

Data Evaluation and conclusions

What happened to the Cr?