Soil Chemistry and Microscopic Animals

Soil is a combination of inorganic minerals, organic matter and living organisms. Soils play a critical role in terrestrial ecosystems and biogeochemical cycling. The living organisms in soil include large species like plants, earthworms and insects but there are also many microscopic organisms: bacteria, fungi, algae and animals. Nematodes, Rotifers and Tardigrades are common microscopic soil animals.

The distribution of living organisms in soil ecosystems is influenced by the physical and chemical properties of the soil. In this activity you will be collecting soil samples and analyzing their physical and chemical properties. You will also be observing and counting the microscopic animals living in the soil samples. Additionally, you will compare your local soils with published data on soils from Antarctica.

As you work through these activities record your results below:

Soil Sample

1. Record your soil sample ID _____.

2. Where was your soil sample collected? (record GPS coordinates if possible)

   _____

3. What was the local environment of your soil sample (e.g. habitat, slope, aspect)?

   _____

   _____

Use the protocols provided by your teacher to measure the gravimetric soil moisture, pH, and electrical conductivity of your soil sample. Record your results below.

4. Gravimetric Soil Moisture

A. Mass of the soil can and lid _____g

B. Mass of soil can, lid and soil (add approximately 50 grams of soil) _____g

C. Mass of soil can, lid and soil after 24 hours in the drying oven _____g

D. (B-C/C-A) * 100 = _____% g/g

5. pH

A. Measured pH of 1:2 soil to water mixture after 10 minutes _____.

6. Electrical Conductivity

A. Measure the EC of a 0.01M KCl solution _____

B. Measure the EC of a 1:5 soil to water dilution after 10 minutes _____µS/cm

C. Temperature corrected EC of soil sample = (1,411.8/A) * B

_____ µS/cm

Measure approximately 50 grams of soil and use the protocol provided by your teacher to set up a Baermann funnel. Record the exact amount of soil measured. After 24-48 hours transfer 10-20 ml of water from the bottom of the baermann funnel to a conical tube or a counting dish.
Using a stereomicroscope observe the various types of animals in your sample. You likely will have lots of nematodes. Use physical characteristics like size, shape and behavior to identify the different types (morphospecies) of nematodes. Describe the types below:

7. Microscopic Soil Animals

A. Amount of wet soil placed in Baermann funnel _____g

B. Nematode type #1 (description) - _____

C. Nematode type #2 (description) - _____

D. Nematode type #3 (description) - _____

E. Other species (descriptions) - _____

_____

Move the dish back and forth systematically to count the nematodes in the dish. You may choose to count the total nematodes or you can count the nematodes of each morphospecies. The grid on the bottom of the dish will help you keep track of the animals so you don't double count.

F. Nematode type #1 (count) - _____

G. Nematode type #2 (count) - _____

H. Nematode type #3 (count) - _____

I. Total Nematodes (count) - _____

J. Total Rotifers (count) - _____

K. Total Tardigrades(count) - _____

Data Analysis and Comparisons

Examine the article "Ecological Biogeography of the Terrestrial Nematodes of Victoria Land, Antarctica" (Adams et al. 2014). Pay particular attention to the information about habitat for *Scottnema*, *Eudorylaimus* and *Plectus* (on pages 36, 44, 50 and 56). Use the information in the article and the table below to make predictions about the relative distribution of nematodes according to the chemical and physical characteristics of Dry Valley Soils.

	Soil Characteristics		
Species	Soil Moisture	pH	Electrical Conductivity
Scottnema			
Eudorylaimus			
Plectus			

A. Which nematodes are likely to occur together? Which are likely to occur alone?

Navigate to http://www.mcmlter.org/content/soil-elevational-transect-experiment and download the Soil Elevational Transect Experiment data as a .csv file. You can also find explanations of each of the experiment and each of the data fields on the webpage. For this investigation, you will use six columns of data: SOIL_WATER_CONTENT, STL, ETL, PTL, PH, and CONDUCTIVITY. You may choose to hide or delete the other columns. To simplify your comparisons, delete all data rows that have missing values for any of the three soil characteristics (i.e. soil_water_content, pH, conductivity). You may find it useful to sort the data in order to do this.

B. How many rows of data do you have left? _____

Once you have eliminated the missing values investigate the data by finding which of the three species are found together and which are found in isolation.

C. Which species is found in isolation? _____

D. Which species is sometimes found with only one other species? _____

E. Which species is only found in the presence of both of the other species? _____

F. Calculate the mean Soil Water Content, pH, and Electrical Conductivity for samples that contain only the species listed in 'C' above.

Soil Water Content _____% g/g

pH _____

Conductivity _____ µS/cm

G. Calculate the mean Soil Water Content, pH, and Electrical Conductivity for samples that contain only two of the three species.

Soil Water Content _____% g/g

pH _____

Conductivity _____ µS/cm

H. Calculate the mean Soil Water Content, pH, and Electrical Conductivity for samples that contain all three of the species.

Soil Water Content _____% g/g

pH _____

Conductivity _____ µS/cm

I. How do your calculated means fit with your predictions about the distribution of nematodes in the McMurdo Dry Valleys?

J. How does the soil water content of your sample compare to the McMurdo Dry Valley data?

K. How does the pH of your sample compare to the McMurdo Dry Valley data?

L. How does the electrical conductivity of your sample compare to the McMurdo Dry Valley data?

M. Calculate the number of nematodes/dry kg of soil from your soil sample.
Use the percent soil moisture calculated in part 4 (Gravimetric Soil Moisture) and the data recorded in part 7 (Microscopic Soil Animals).

Nematodes per kg = 1000*(number of nematodes/(weight of soil sample-(weight of soil sample*(percent soil moisture/100))))

_____ nematodes/kg dry soil

N. How does the number of nematodes in your sample compare to the Antactic Dry Valleys?

Literature Cited

Adams, B. J., Wall, D. H., Virginia, R. A., Broos, E., & Knox, M. A. (2014). Ecological biogeography of the terrestrial nematodes of Victoria Land, Antarctica. ZooKeys, (419), 29-71. doi:10.3897/zookeys.419.7180

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Template for Nematode Counting Dish Gridlines