LIVING SOIL

Soil breathing

Home gardening has become popular hobby recently. Those who cannot grow their own vegetables, spices and fruits in a garden, use the option to purchase such crops from small farmers or from so-called organic farms. Growing and selling crops under the name of bio has a lot of rules, one of them is limited artificial fertilization. Mr. Rabbit would like to grow his own vegetables, also, if possible, with a minimum of artificial fertilization. The best is to have land with soil containing many soil organisms. Mr. Rabbit has an opportunity to buy a land in different locations, but he does not know which siol has the best quality.

Help Mr. Rabbit with choosing the best option to gain soil with the greatest number of microorganisms.

What you might need to know

Soil is not a dead material, there are soil organisms living inside, which contribute to its creation. These organisms also breathe, therefore consume oxygen and excrete carbon dioxide.

1. Write the summarizing equation of aerobic breathing:

Breathing of soil organisms is shortly called soil breathing. The intensity of soil breathing depends mostly on temperature, moisture, pH, the depth of the soil horizon, concentration of available nutrient and the concentrations of soil organisms.

2. Soil organisms are called in summarizing term: _____ .

3. Name at least five soil organisms:

    _____
    _____
    _____
    _____
    _____

4. Remember some ecologically significant functions of soil microorganisms and list at least three:
    _____
    _____

## Before you go to laboratory

Moreover, the plants breathing also with their underground parts affect the concentration of gases in the soil and its surface. However, we will observe the soil without plants. There will be several types of soils from ecologically distinct areas: soil from a spruce forest, a meadow, compost, pond mud, sand and soil sold for flower terrace. We will measure the intensity of soil respiration via changes in the concentration of CO_2 and O_2 depending on temperature. Temperature is indeed one of the most important variables affecting the intensity of soil respiration.

1. Make a prediction of how the soil respiration will change according to higher temperature.

_____

2. Draw the dependence in following graphs:
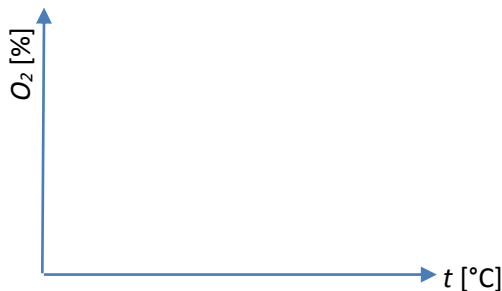
3. Estimate the temperature after which the intensity of soil breathing will not change. What do you think what causes this upper limit?

_____

_____

Explore the world around: measure the data

Each group has received from a teacher one glass vessel and one sample of soil. Finally, you will compare the results together. Put down the type of received sample.

Sample: _____

In the experiment you will use a glass vessel with marked line, temperature sensor, and oxygen and carbon dioxide sensors.

1. What is the purpose of marked line on the vessel? _____

2. What will be examined with temperature sensor and where it will be placed? _____

_____

_____

3. Design the experiment: what will be done to find out the dependence of soil breathing intensity on temperature and draw the apparatus that you will use.

Procedure:

_____

_____

_____

_____

_____

Apparatus:

4. Put down the gathered data in appropriate form – table, graph or text:

O_2 [%]

t [°C]

CO_2 [ppm]

t [°C]
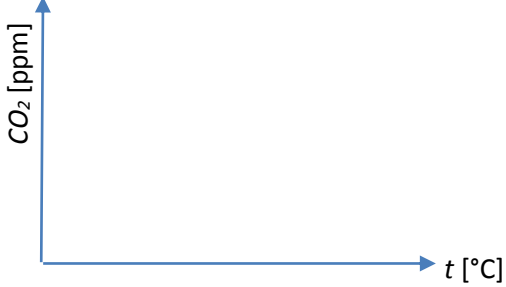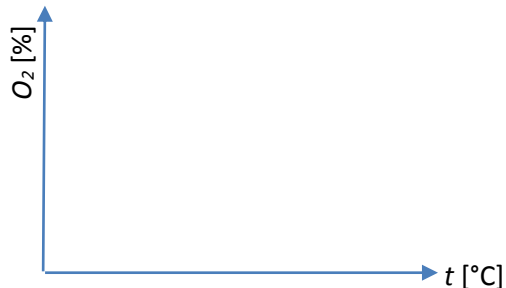
Evaluate the data

Work out the graph of CO_2 and O_2 dependence on soil temperature using graph paper or MS Excel programme (OOCalc) and attach it to the worksheet.

1. Have you reached the limit temperature after which the intensity of respiration does not change? If so, what was your limit temperature: _____

2. Compare your results with other groups results and draw summarizing graphs of carbon dioxide concentration on temperature for all samples; draw the analogous graph for oxygen concentration.
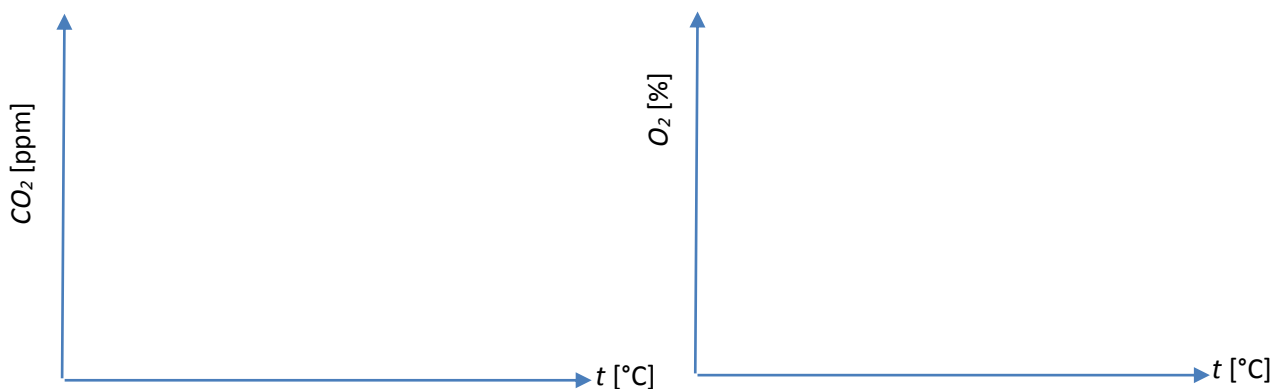
3. Which sample seems to have the most intensive and least intensive soil respiration at room temperature?

The most intensive breathing soil: _____

The least intensive breathing soil: _____

4. In these cases the difference in soil breathing intensity is caused with the amount of soil microorganism in particular sample. Can you explain why there are the most and the least concentration of microorganism in two explored samples?

_____

_____

_____

_____

5. Explain: a) why is Mr. Rabbit interested in the soil with the most concentration of microorganism:

_____

b) how can you make/prepare such enriched soil in case there are not enough microorganisms:

_____

Conclusion

_____

_____

Show your results

Write Mr. Rabbit short letter, where you briefly explain your procedure and your conclusions: what type of soil contains many microorganisms and which the least.

_____

_____

_____

_____

_____

_____

_____

Now you are experienced enough to answer following problem:

Once upon a time there was a town with a beautiful eutrophic meadow nearby. Local farmers, however, decided to remake it into the field. So it happened. Each year they sow the field with grain and reaped in the late summer the harvest thoroughly that there were left almost no organic residues. The farmers fertilized field carefully with mineral fertilizer to achieve good harvest and also herbicides care to minimize the weeds in the grown crop. The harvest was always rich as they were scrupulous farmers. Over time, however, the town began to focus on heavy industry and the field has been left with no care. And what happened! The field did not turn back into a meadow or a young forest, there were just few weed species that died for the winter and in the spring they did not appear again. Their dry stems lay on barren land untouched. It took a long time before the former field recovered again, step by step began to be green again.

What happened to the land that used to be nice meadow and now it turned to dead soil?

_____

_____

_____

_____

Extra questions

1. Explain the term **eutrophic**: _____

2. Explain what mineral fertilizer is, and what else can be used as fertilizer:

_____

_____

_____

_____

3. What are herbicides used for and what other products could be used to protect the grain field:

_____

_____

_____