Gas exchange of peat mosses (*Sphagnum* spec.)

Two different moss species per group are examined regarding their respiration (under dark conditions) and photosynthesis (in the light). The experiment is conducted in enclosed glass vessels, which are connectable to a CO_2 measuring device, and furthermore equipped with optical oxygen sensors. The aim is first, to determine respiration – CO_2 production and O_2 consumption – under dark conditions, and second, to measure photosynthetic CO_2 consumption under light conditions with varying initial CO_2 levels. Finally, the specific respiration rates per gram plant dry mass and time unit are calculated in order to compare the different moss species.

Procedure for dark respiration:

1. Fill previously dark-adapted moss plants into vessels (should be a similar amount for all) and put on the rubber stoppers with open valves
2. Measure and note the phase angle (Φ-value) for initial full atmospheric O_2 levels and the corresponding temperature with the Fibox device (has to be done for each single sensor due to calibration purposes)
3. Measure the intial CO_2 levels with the EGM device (CO_2 expressed as ppm)
4. Close the valves and note the exact time point
5. Keep the samples in darkness under steady temperature conditions

---

6. Now, intermediately, the light measurements can be conducted with the other species. Proceed in the same way as for the dark experiment (O_2 measurement is not needed now)
7. Use your breathing air and the connected EGM to obtain CO_2 starting levels around 2000 and 5000 ppm. Be creative! Write down the exact CO_2 levels.
8. Quickly close the valves and illuminate the glass vessels with a lamp – try to keep the light conditions equal for all treatments.
9. Measure the time between the start and the end point – latter is reached when the CO_2 level deceeds 1000 ppm.

---

10. After that, measure O_2 for the dark treatments and note the time point
11. Connect the EGM, open the valves and measure CO_2
12. Remove the moss samples from the vessels and dry them in the oven, thereafter weigh their mass. Now you can calculate the specific respiration rates and the respiratory quotient with the provided Excel-sheet.

Oxygen measurement in soils

The amount of free, molecular oxygen (gaseous + dissolved O_2) in field soils at two different sites, one drier and one wetter, will be measured by aid of sensor probes (Fibox PSt3). These are introduced into the soil to the desired depths. Now, the probes should not be moved until O_2 levels have equilibrated – which takes at least half an hour. After that, the Fibox device is connected. Be careful not to move the sensor tip in the soil while handling the device! You always need to measure the soil temperature in each depth near the sensor location for purposes of correct O_2 calculation. Insert the temperature sensor into the respective depth and wait until the value does not change anymore. You have to write down following parameters for each measurement (use the list): sensor number, phase angle, temperature!

On the two sites, three plots (replicates) are measured, for each plot in depths of 5, 10 and 20 cm, so that there are 18 single measurements overall. Besides field measurements, we will additionally

determine soil O_2 levels in the same depths within prepared pots with peat and sand in the Botanical Garden. This will be done during the second week of practicals.

Soil respiration

Two distinct types – one organic with high amounts of undecomposed peat, another with a higher proportion of mineral substances - will be sampled in the Pfrunger Ried. The cores will be homogenized and roots will be removed.

To calculate the water content, a small share (f.i. 20 g wet mass) is cut from each of the fresh soil cores. You weigh the exact wet mass and oven-dry the sample overnight at 70 °C, afterwards weigh the dried sample again. Now you can calculate the gravimetrical water content (mass % of water in relation to soil dry mass). (The dried samples are further used for pH measurements and total carbon and nitrogen analyses with the LECO device). The wet, homogenized and de-rooted soils are used for the incubation experiment. Prior to starting the incubation, the samples are allowed to "settle" for approx. 24 hours at 20 °C (microbial activity is high and would lead to changeable results if measuring directly after the disturbance).

The procedure of incubation is pretty much the same as for the *Sphagnum* moss incubation. Knowing the water content of the sampled soils, you can calculate the wet weight that is needed to obtain the desired dry mass of 5 g per glass vessel.
You measure both, CO_2 and O_2, at the starting point (shortly before closing the valves) and at the end. You can finally enter the determined gas concentrations into the calculation sheet in order to get the soil-specific respiration rates. As a last step, the gas exchange rates per gram dry soil and hour can be recalculated to rates per gram C, which gives a better impression of the soil organic matter turnover and mineralization.

The incubation will be run over the weekend, starting on Friday and ending on Monday. For each soil type, you will measure two layers (0-10 and 10-20 cm) with three replicates each, so that each group measures six samples.

O_2 concentrations in the rhizomes of *Typha domingensis*

Typha spec. is a wetland plant genus that can actively transport atmospheric air via its aerenchymatic tissues from the leaves downwards to the rhizomes and roots. The rates of gas transport through the plant, and also the O_2 levels in the rhizomes, are dependent on external microclimatic parameters, as light intensity, air temperature and humidity, that control the mechanisms driving the air uptake and transport.

We will examine, how well the aeration functions under dark and light conditions with varying air humidity (phytochamber!). Therefore, micro-optodes will be used to record the changeable O_2 levels in the rhizomes. For insertion, the optodes are encased by glass capillaries. They will be put into pre-drilled holes in the aerenchymatous tissues of the rhizomes. On the first day, we will insert the sensors into the rhizomes. The measurement itself will be done on the second day.