Background on the pH indicator brohmthyl blue

The reactants (carbon dioxide and water) and products (glucose and oxygen) of photosynthesis can be detected using various experiments. For example, pH indicators are suitable for this purpose, which show the content of carbon dioxide or oxygen in the experimental preparations by means of colour changes.

For the experiment, the pH indicator bromothymol blue is used, which has a very narrow range (pH value between 6.0 - 7.6). The indicator has no hazard potential and can therefore also be used in experiments with learners. Moreover, it has no influence on the photosynthesis reaction. Bromothymol blue shows a yellow colouration at low (acidic) pH (high carbon dioxide content, in the form of carbonic acid) and a blue colouration at higher (basic) pH (low carbon dioxide content, in the form of carbonic acid). At a neutral pH value (7), on the other hand, a greenish colouration can be observed.

Carbon dioxide, which is normally gaseous, is present in the preparations in the water. By adding the exhaled air with a drinking straw, this can be made immediately visible with the indicator. The carbon dioxide reacts with the water to form carbonic acid. This in turn decomposes into the hydrogen carbonate ion and the oxonium ion (see reaction equations). This reaction explains the changeover to the acidic pH range.

Reaction equations

$$CO_{2\,(g)} \longrightarrow CO_{2\,(aq)}$$

$$CO_{2\,(aq)} + H_2O_{\,(l)} \longrightarrow H_2CO_{3\,(aq)}$$

$$H_2CO_{3\,(aq)} + H_2O_{(l)} \longleftrightarrow H_3O^{+}_{\,(aq)} + HCO_3^{-}{}_{\,(aq)}$$