

Plant-A-Plant Light Laboratory guide

Task

This experiment examines **light** as a limiting factor to plant growth. To test how plants respond to light you will set up a control flowerpot placed in an area of natural light (the LIGHT treatment); and a DARK treatment, which will be a flowerpot of seedlings grown in the absence of light. You will observe height and leaf color throughout the growth period and then calculate differences in biomass, root:shoot ratio and carbon fixed during photosynthesis.

Prepare and Perform Experiment

All directions in this lab are written for one experimental replicate. This means there is one flowerpot of seedlings grown in natural light and one flowerpot of seedlings grown in darkness. Note that at least three replicates are recommended for this experiment.

Materials and Tools (per replicate)

- 12 maize seedlings
- 2 flowerpots (approx. 0.75 liter volume)
- Growing medium: gardening perlite or sand (2 liters)
- Fertilizer containing basic nutrients (for example, Kristalon Start or Miracle Gro)
- Distilled water (2 liters)
- Measuring cylinder
- Laboratory scale (accuracy of 0.01 g)
- 1 beaker or glass jar (volume 100 ml)
- 1 bottle (volume 1 liter) for fertilizer solution
- Pencil, permanent marker
- Scotchtape (cellotape) for labeling
- Large cardboard box (depth approx. 30 cm)
- Aluminium foil
- 4 spacers to support the cardboard box (10-15cm height e.g. yogurt cups)
- Black paper (50 x 50 cm)
- Laboratory Data Sheet – Light*
- Student Laboratory Questions Sheet*

Preparation

- 1) If directed by your teacher, calculate the amount of materials needed for more than 1 replicate.
- 2) Mix 1 liter of fertilizer solution with a concentration of 0.5g/l for watering during the experiment. Weigh 0.5 g of fertilizer and dissolve into one liter of distilled water. Pour fertilizer solution into a labeled bottle and store in a cool, dark place.
- 3) Set up the LIGHT treatment by choosing a well illuminated place (such as a window sill) in the classroom or laboratory.

- 4) Set up the DARK treatment.
 - a) Plants in the dark treatment will not have access to light energy essential for photosynthesis, but they should have all other conditions for growth – sufficient input of both water and mineral nutrients, availability of carbon dioxide and oxygen and ideal temperature.
 - b) Cover the surface of a large cardboard box with foil – it will reflect light and therefore avoid overheating of the inner space of the box. This will also prevent any light from entering the sides of the box.
 - c) Lay black papers on the window sill in the area next to the LIGHT treatment. (To prevent reflection of light upwards toward the plants).
 - d) Place the spacers (yogurt cups) on the corners of the black paper and rest the cardboard box on the spacers. Boxes shouldn't stand directly on the black surface since it may prevent air from getting to the plants inside.
- 5) Prepare 2 flowerpots by filling them with gardening perlite or sand (to about 2 cm below the edge). When using sand rather than perlite, it is necessary to wash it with tap water very carefully and dry it a little before putting it into the flowerpots.
- 6) Label each flowerpot to identify the experimental treatments.

Plant and Observe Seedlings

- 1) Transplant 5-6 young seedlings from the germination tray into each flowerpot.
- 2) Place the light pot in the designated area and dark pot under the cardboard box.
- 3) Choose a watering container. The watering quantity will always be 100 ml. Water the plants in each pot every other day with 100 ml of the 0.5 g/l fertilizer solution. The first day of watering will be when you transplant the seedlings.
- 4) Grow plants at room temperature for **11 days**. During this time observe and record differences in plant height and leaf color between the natural light and the dark treatment (Table 1 of the *Laboratory Data Sheet*). Begin observations on day of transplant.

Harvest Plants and Make Calculations

Material and tools (*per replicate*)

- Sink / washbasin with tap water
- Plastic trays (it is possible to re-use the germination trays)
- Scissors (ideally fine surgical ones or nail scissors) or razor blade
- Aluminium foil
- Permanent marker
- Pencil
- Laboratory scale (accuracy of 0.01 gram)
- Absorbent paper (paper towels, filter paper, etc)
- Laboratory Data Sheet*- Light
- Data Summary and Analysis Sheet* -Light

**Note: kiln or drying oven is also necessary

Harvest Procedure

All plants from each flowerpot will be harvested together as a set.

- 1) Before harvesting prepare 3 squares of aluminium foil (approx. 15 x 15 cm) for each flowerpot: one for roots, shoots and seeds. Label them with a marker – write the treatment information, such as **roots**, **LIGHT** and the number of replicate.
- 2) Remove plants from the substrate being careful not to break the roots and place them in a plastic tray filled with tap water. Wash roots completely, do not leave grains of substrate on them (especially important if using sand as substrate). Place plants on absorbent paper (paper towels, filter paper, etc) to dry roots.
- 3) Use scissors to divide plant into its parts: shoot, roots and seed residues. Group like parts from the same flower pot together.
- 4) Place each plant part group into its own labeled foil packet– KEEP THE LABEL VISIBLE.
- 5) Puncture the foil envelopes/packets several times using the small point of the scissors, a pin or a paperclip to allow evaporating water to escape.
- 6) Weight all packets and record the fresh weight in Table 2 of the *Laboratory Data Sheet*.
- 7) Place the packets into kiln or oven at 90°C and dry them for 8 to 12 hours. It is also possible dry them at lower temperatures but for a longer time (e.g. 60°C for 2 to 3 days).

Report Results

- 1) Remove the foil packets from the kiln or oven (carefully as they will be hot) and weigh individually on the scale. Record your packet dry weight value on your worksheet.
- 2) Follow the instructions on the student worksheet to calculate:
 - a) Increase in biomass (in grams of dry weight) (Table 4)
 - b) The root-shoot ratio using plant dry weights (Table 5)

Analyze Data

- 1) Compare experimental treatments (*Data Summary and Analysis* Table 6) by determining the replicate average.
- 2) Follow instructions on the student worksheet to graph interesting and/or important results, create a summary table, and record initial observations.

Discussion and Conclusions

- 1) Fill out the Post-Lab section of the *Student Laboratory Questions* sheet.
- 2) Follow instructions on the student worksheet to evaluate your hypothesis, answer further questions and describe potential sources of error.

Share Findings and Conclusions

- 1) All scientists, once they have completed their investigation, share their findings with peers in their community. Follow the instructions provided by your teacher to share your work.