ANSWER KEY.

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The Seedling Mass Ledger

Biology | ANSWER KEY

Sample answers and data. Accept answers that match the group's own data and reasoning.

Draft lab. This lab has not been tested in a classroom yet. Your teacher may change some steps, times or amounts.

The Puzzle

A seed sprouting on a wet paper towel gets nothing but water. There is no soil and no food. Does the seedling gain matter as it grows, or lose it? Does light change the answer? You will keep a ledger of the seedlings' **dry mass**, the mass left after all the water is removed. Dry mass is the carbon-based molecules the plant is built from.

Question

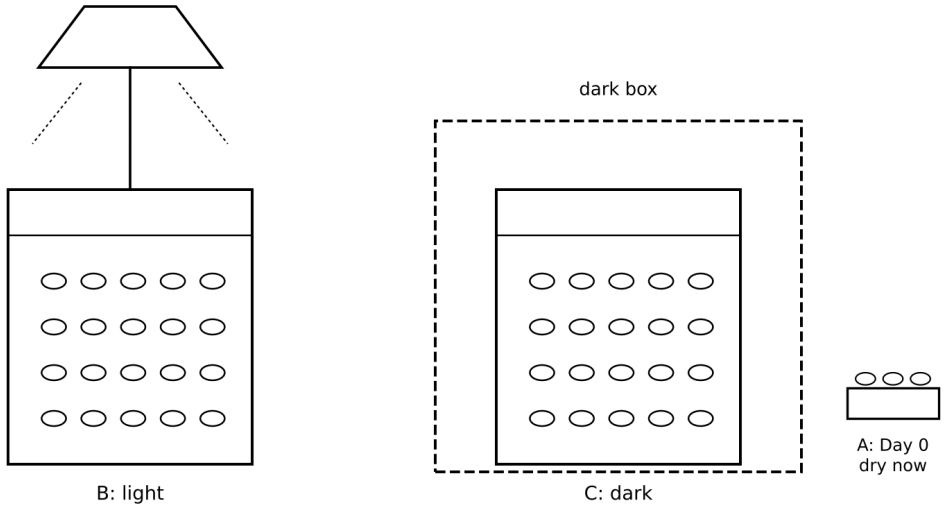
How does the dry mass of seedlings change over 10 days in the light and in the dark?

Safety

- Use untreated seeds only. Treated seeds are coated with pesticide (often a bright color).
- Do not eat seeds or seedlings. Wash your hands after handling them.
- Only your teacher uses the drying oven. Dried seedlings and trays can be hot.

Materials (per group)

- 60 untreated wheat seeds (or mung beans)
- 3 paper towels, 2 zip bags or clear cups with lids, marker
- Cardboard box (the dark box) and a lamp or bright window
- Spray bottle of water
- 3 foil or paper drying trays (shared oven)
- Balance that reads to 0.01 g (shared)



Twenty seeds in each bag. One bag goes under the lamp, one in the dark box.

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Before the Lab

1. Predict: after 10 days, will the dry mass of the seedlings **in the dark** be more than, less than, or the same as the dry mass of the seeds they came from? Explain your thinking.

   Answers vary. A strong prediction: less, because the seedlings use stored food for energy and cannot make new food without light.

2. Predict the same thing for the seedlings **in the light**. Explain.

   Answers vary. A strong prediction: they lose less mass, or may gain, because light lets the leaves make sugar from CO_2 once they turn green.

Procedure

Day 0

1. Count out three sets of 20 seeds. Pick seeds that look whole and similar in size.
2. Set A is the **Day 0 baseline**. Label a drying tray with your group name and "A", put Set A on it, and give it to your teacher to dry.
3. Wet two paper towels until damp but not dripping. Spread Set B on one towel and Set C on the other. Fold each towel over and slide it into its own bag. Label the bags B (light) and C (dark).
4. Leave each bag open a little at the top for air. Put bag B under the lamp. Put bag C inside the dark box.
5. Check the bags every school day. Mist them if the towels start to dry out.

Day 10

1. Remove every seedling from bag B, roots and all, and place them on a tray labeled "B". Do the same for bag C on a tray labeled "C". Do not lose any pieces, but leave the paper towel behind.
2. Your teacher dries all trays overnight at 60 to 70 °C, until the mass stops changing.
3. Next class, find the dry mass of each set to 0.01 g. Record it below.

Data

Table 1. Our group's dry mass ledger

Set	Treatment	Dry mass (g)	Change from Day 0 (g)	Percent change
A	Day 0 seeds	**0.84**	0	0%
B	10 days in light	**0.80**	**-0.04**	**-5%**
C	10 days in dark	**0.65**	**-0.19**	**-23%**

Percent change = (final dry mass - Day 0 dry mass) ÷ Day 0 dry mass × 100

Table 2. Class data

Treatment	Class average percent change	Lowest group	Highest group
Light	**-4%**	**-12%**	**+6%**
Dark	**-21%**	**-27%**	**-15%**

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Analysis

3. Show your percent change calculation for Set C.

(0.65 g - 0.84 g) ÷ 0.84 g × 100 = -23% (sample). The dark seedlings lost about one fifth of their dry mass.

4. The dark seedlings grew taller, yet their dry mass went down. Where did the missing matter go? Name the process and the gas.

Cellular respiration broke down stored sugars and starch in the seed. The carbon and oxygen left as CO_2 gas (and some hydrogen as water vapor). The mass went into the air.

5. Compare Sets B and C. What did light allow the B seedlings to do, and where did that new matter come from?

Light let the green leaves photosynthesize. They took CO_2 from the air and water from the towel and built sugars, which replaced some or all of the mass lost to respiration.

6. Did the light seedlings stop respiring? Use the data to explain.

No. All living cells respire. The light seedlings still lost mass early on (before leaves formed), and their final mass is the sum of mass gained by photosynthesis minus mass lost by respiration.

7. Why do we measure dry mass instead of fresh mass?

Fresh mass is mostly water, which the seedlings soak up from the towel. Dry mass shows only the carbon-based material the plant is built from.

8. Atoms are not created or destroyed. Write one sentence that "balances the ledger" for the dark seedlings.

Mass of the seeds at Day 0 = mass of the seedlings at Day 10 + mass of the CO_2 and water released by respiration.

9. Claim, evidence, reasoning: Where does the dry mass of a growing plant come from?

Claim

Most of a plant's dry mass comes from carbon dioxide in the air, built into sugars by photosynthesis.

Evidence

Seedlings without light lost about 20% of their dry mass in 10 days; seedlings with light lost much less or gained (sample class data).

Reasoning

With no soil, the only sources of matter were water and air. Photosynthesis uses light energy to join CO_2 and water into sugar, and respiration releases CO_2.

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