



Lesson Plan for Positive Actions

Please send your Queries/Submit the lesson plan to Dr Pramod Kumar Sharma at pramod@fee.global

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2. Has the lesson plan tried in a classroom (Please write a brief)

Yes, this lesson plan has been implemented several times with students in primary and middle school.

It has been adjusted to maximise its didactical potential.

Students enjoy the lessons very much, not only because they are mostly outside the classroom, but also because they engage very well in the experimental procedures necessary.

3. The lesson plan – *Studying plants' contribution to the water cycle through evapotranspiration*

Background information describing the key concepts in the lesson plan and which SDG they are linked to.

- A. **Introduction:** Water is available in nature in different physical states: liquid (rain), solid (snow or hail) and gas (water vapour). The circulation of water in this cycle is extremely important for the regulation of the climate. This is particularly critical because water vapour is an important greenhouse gas (GHG). Along water vapour, CO₂ is a GHG, too. [SDG13](#) Plants play a significant role in the regulation of these two gases in the atmosphere, for they consume water and CO₂ in the photosynthetic processes and, at the same time, they lose water vapour mainly through their leaves. Different plants have different adaptations to regulate the amount of water vapour that they lose through evapotranspiration. Therefore, we can learn a lot about plant diversity by studying how they deal with water loss. [SDG15](#)

- B. **Age Group** – This activity is planned for students between 10 to 14 years old. Nevertheless, it can be adapted to ages 6 to 9.
- C. **Objectives or Learning Outcome/s** Select from the learning outcomes listed in the publication.

SDG	Learning Outcome
SDG15 – Life on Land	Protects and promotes the importance of biodiversity. Spends time in nature [, visit nature parks, sanctuaries].
SDG13 – Climate Action	Increases [<i>the importance of</i>] green spaces and other sinks of carbon.

- D. **Time required to deliver the lesson plan.**

3 x 50 minutes

- PART 1 - 50 minutes, in the classroom, for contextualization of the experimental activity;
- PART 2 - 50 minutes, in the school garden, to carry out the experimental activity;
- PART 3 - 50 minutes, in the classroom, to curate and interpret the collected data.

- E. **Resources Required to deliver the lesson plan (Material, equipment and reading resources)**

Material per work group: 2 clean plastic bags (20cm x 15cm), a stapler, a stopwatch and a camera (these two items can be replaced by a mobile phone). All groups can use the same scale to measure the amount of water collected.

- F. **Activity** – Steps or description of how the lesson plan will be conducted/facilitated by the teacher.

Study problem: How much water is lost by evapotranspiration, in plants of different species?

PART 1 - Contextualization of experimental activity

- A. Situate the concepts used in this activity in the water cycle.
- B. Present some relevant details of plant physiology involved in the evapotranspiration process.
- C. Give each group the name of a different kind of plant and provide some information about the species (fact sheet, field guide or online information query). The plants chosen must be the ones they are going to study in the schools garden.

PART 2 - Experimental activity

Description of the experimental activity:

1. Weigh the empty bag and write down the value obtained.
2. Each group will be assigned a different kind of plant (if possible, use adult trees).
3. Each group chooses a leaf that is directly exposed to solar radiation.
4. The teacher should check that the chosen leaf has an equivalent area in all groups, so that the final results are comparable.

5. All groups, at the same time, place a leaf inside the plastic bag, closing it (with the stapler), around the petiole. Keep another bag, empty and closed, near the plant studied.
6. Mark the time interval of the test - 20 minutes.
7. At the end of the designated time, all groups remove the bag from the leaf without damaging it; immediately close the bag and weigh it. Record the result and share it with colleagues.

PART 3 - Discussion of the results obtained in the experimental activity

Some suggestions for discussion in each group:

- a) Identify, in this experimental activity, an independent variable, a dependent variable and the controlled variables.
- b) Explain the importance of the plastic bag being clean, at the beginning of the experimental activity.
- c) Refer the importance of the second plastic bag mentioned in point 5 of the experimental procedure.

Some suggestions for discussion among groups:

- c) Compare the evapotranspiration values obtained in each species.
- d) Relate the evapotranspiration values obtained by each species to the adaptations of this species to their natural environment.
- e) Discuss the importance of plants directly to the water cycle and, indirectly, to the balance of the atmosphere and biosphere.

NOTES:

- The direct contact with plants and the fact that they are the object of this study helps students to acknowledge that plants are living beings.
- In this activity the biological material is used *in situ*, without harming any plant or part of it.
- The manipulation of the leaves is an opportunity to show the differences between the upper and lower leaf surfaces, relating these differences with the functions that they perform.
- The use of plants of different species introduces the experimental character in this activity, since this independent variable is manipulated. The controlled variables are the approximate size of the leaves used, the decontamination of the bag and the time interval of the test. The abiotic conditions in which this experiment takes place (temperature, humidity, sun exposure, wind, among others) will be the same for all the groups. The dependent variable will be the amount of water lost by evapotranspiration, for each species.
- Direct exposure to solar radiation is important to achieve measurable results during the time spent on this test (20 min).

- If there is no scale in the school that is sensitive to tenths of a gram, the evaluation of the evapotranspiration rates may be relative, *i.e.*, the results are simply compared: the species that lost more water to the species that lost less water.

G. **Evaluation and Assessment** – How achievements of Outcomes both in short term and long term will be evaluated after the lesson is delivered?

Regarding the experimental activity, each group of students will make a scientific report where they integrate the results they found experimentally in the theoretical framework previously given by the teacher and the information they gathered during the investigation period (part 1). In this report they will answer the questions mentioned in part 3, showing their understanding on the importance of plants in the water cycle, the balance of the atmosphere's chemical composition (specially in terms of water vapour and CO₂) and, therefore, climate change (SDG15).

It is expected that the contact with the school garden will potentiate the student's respect for biodiversity, contributing to increase the time they spend in nature, either in the school garden or in other natural spaces (SDG13). A questionnaire can be periodically applied to the students, to evaluate the frequency of spontaneous use of the school garden.

H. **Suggestions of variation or further reading of the lesson plan**

The following links can be explored in the classroom in part 1 or 3:

<https://www.youtube.com/watch?v=mc9gUm1mMzc>

<https://www.youtube.com/watch?v=U4rzLhz4HHk>

I. **References** – Acknowledging the resources that were used while developing the Lesson Plans.

Bentley, M., Ebert, C., & Ebert II, E. (2007). *Teaching constructivist science K-8*. Thousand Oaks: Corwin Press.

Herr, Norman (2008). *The sourcebook for teaching science, Grades 6-12*. San Francisco: Jossey-Bass.

Peacock, G.; Sharp, J.; Johnsey, R.; Wright, D. (2017). *Primary Science: Knowledge and understanding*. London: Sage Publishers Ltd.