

Clean and Green

SUMMARY INFORMATION

Keywords

Pollution, pollutants, plant life degradation

Topics Covered

Biology

Target Grade(s)

7, 8

Estimated Time Required

5 hours

LESSON

Goals and Pre Requisites

Goals

- To develop ideas to combat the results of pollution over plant life
- To understand the chain reaction caused due to plant depletion

Pre Requisites

Characteristics of Plant life

Instructional Objectives

Students would develop:

- Procedural thinking
- Observation skills
- Creativity

Instructional Resources

Problem Statement

Plant growth and sustenance has been obstructed due to the prevalence of various forms of pollution. This has caused serious damage to the plant life cycle and resulted in abundant depletion. How can we come up with methods to help plants battle the odds against pollution?

Background

Agricultural crops can be injured when exposed to high concentrations of various air pollutants. Injury ranges from visible markings on the foliage, to reduced growth and yield, to premature death of the plant. The development and severity of the injury depends not only on the concentration of the particular pollutant, but also on a number of other factors. These include the length of exposure to the pollutant, the plant species and its stage of development as well as the environmental factors conducive to a build-up of the pollutant and to the preconditioning of the plant, which make it either susceptible or resistant to injury.

Effects of Pollutants on Plant Structure

Leaf Structure

Pollutants such as ground-level ozone physically damage leaves by causing chlorosis, or an abnormal yellowing of the leaves, resulting from a deficiency of chlorophyll. Chlorophyll is vital for photosynthesis. This molecule fuels the food-making process by capturing energy from the sun. Without chlorophyll, a plant cannot manufacture food or energy. In areas with high concentrations of ozone, parts of the leaf will die as a result of exposure.



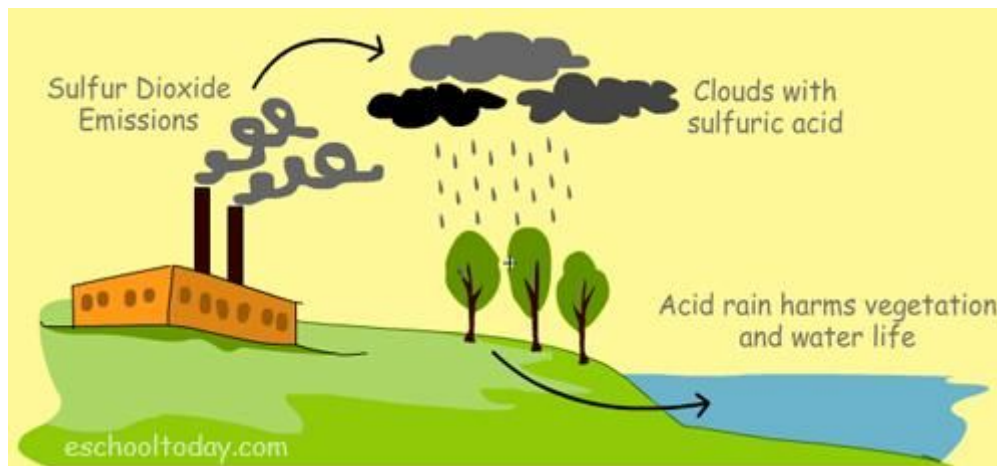
Delayed Flowering

Exposure to vehicle exhaust impacts plant structure by delaying the flowering of exposed plants, as reported in a study published in the journal

"Environmental Pollution." A stressed plant will not flower but, rather, will use its resources to survive the threat. The study also noted an increase in senescence or plant aging. Because of the concentration of emissions, plants in urban environments were identified to be at the greatest risk.

Root Damage

Whether the source is acid rain caused by sulphur dioxide emissions or acidic mine drainage from abandoned mines, acidic soils create a complex scenario that results in plants' failure to thrive. Acidic conditions mobilize aluminium ions, normally present in a non-harmful form in the soil. The mobilized aluminium damages root systems and prevents calcium uptake. The result is an overall slowing of plant growth from a lack of nutrients. Aluminium and other heavy metals can further impact plant structure by reducing soil bacteria. A reduction in soil micro-organisms prevents the breakdown of organic matter, resulting in a reduction of available nutrients.



Stomata Damage

Stomata are the tiny pores found on leaves. Their function is to act as sites of gas exchange between the plant and the atmosphere. Carbon dioxide is taken up through the stomata and oxygen released during photosynthesis.

Procedure

1. Introduce the **Problem Statement** to students.
2. Form students into groups of four.
3. Allow them to brainstorm with their groups, on the given **Problem Statement**.
4. Each group must come up with their unique solution(s) to the given problem.
5. Each group can compare their solutions with fellow groups and with their teacher to check on the feasibility of their solution.
 - In order to check on feasibility, instruct students to discuss with their team mates and have a rough sketch of their plan before

constructing it. Students must be able to provide justification for their choice of materials.

6. Ask students to build a timeline (within the estimated amount of time provided under summary information) and ensure that all members of each group are involved in planning the project in terms of availability and cost of materials.
7. Students must make sure that the design incorporated in their process would address the existing problem.
8. Each group can present their solution and evaluate feasibility with peer groups and the teacher.

Sample Methodology

Note: The following is an example of how the given **Problem Statement** might be addressed. **For Teacher Reference only.**

Materials Required

Plant saplings, pots, paper plates, string, petroleum jelly, candle

Procedure

1. Take two of the same plants or saplings and put them in suitable pots. Mark one plant as A and the other as B. Make sure both plants have good access to sunlight, water etc. Take note of the process of plant growth and development.
2. Expose plant B to regular smoke by lighting the candle. Students should document the regularity of smoke exposure and correlate it with the noticeable changes in the health of plant B, when compared to plant A.
3. Using a string and paper plate, hang the plate near the plant. Rub petroleum jelly on the plate side that is near the candle, and continue the smoke experiment. Students should now note the effect of the plate in capturing the pollution (smoke particles).



Conclusion

Plant life would require a restoration model that does not call for an immediate uproot, if damaged due to pollution.

Extension

- Incorporate the same idea to the mechanism of respiration in Human beings. As the lungs are affected by higher order pollutants, come up with methods that would restore the wellbeing of the lungs.
- Students can work on a way to incorporate the plate with petroleum jelly example in an existing area where plants are regularly exposed to pollution.
- Students can research on plants that are said to have air pollution reducing properties. How might these plants be incorporated in their environment to reduce some of the damaging effects of air pollution?

Assessment and Rubric

Define the need or problem – Did students identify the need to resolve this problem? Were they able to relate the problem to their own environment?

Come up with ideas - Did students weigh various possibilities brainstorm on various ideas before arriving at a solution? Did each group collaborate effectively to (1) work within the time given (2) give equal opportunity for participation (3) consolidate relevant information (4) provide rationale for their decisions and choices.

Select the most promising idea or design - Were students able to evaluate the feasibility of their solution to the given problem statement? On what basis was the feasibility of the solution determined?

Communicate and plan the project – Were groups able to provide justification for their choice of materials? Were students able to see completion of the activity within the estimated time?

Create/Build and test a design –Were all members of the team participative during the course of the activity?

Evaluate and revise the design – Were student groups able to present their solutions in a clear and distinct manner with other groups? Were they keen on improving their model further?

Credits

- <http://www.omafr.gov.on.ca/english/crops/facts/01-015.htm>
- <http://www.forestrynepal.org/notes/silviculture/locality-factors/16>
- <http://smallbusiness.chron.com/effects-pollutants-plant-structure-17119.html>
- <https://i.ytimg.com/vi/t63h7QErVU/maxresdefault.jpg>
- <http://abioticfactorairpollution.weebly.com/>
- <http://eschooltoday.com/pollution/air-pollution/effects-of-air-pollution.html>
- <https://www.youtube.com/watch?v=9uVdi-3AqRE>