**PLANT ADAPTATIONS AND THE EFFECTS GLOBAL WARMING ΟN ENDANGERED AND/ OR FARMED PLANT SPECIES**

**Learning aims:**

1. To learn relevant plant terminology, such as, xerophytes, hydrophytes, mesophytes, halophytes, and plant adaptations mechanisms, such as: stomata, cuticle, large or small surface area to volume ratio, hairs
2. To become able to design and perform an experiment for investigating the effect of temperature or any other specifically selected abiotic factor on the development of Seeds of a selected plant or its seedlings that can be find in the ecosystem under investigation
3. To specify the dependent, independent and control variables of their designed experiment
4. To discuss and evaluate both the validity and the reliability of the outcomes of their designed experiments
5. To inquire about the construction of a greenhouse

**Materials:**

* A photo and keys of a known/named plant that grows in the local ecosystem
* Calculator
* Ruler
* Thermometer
* Hygrometer
* pH meter
* Light meter
* Soil
* Water
* Minerals

Many scientists are concerned about the effect that climate change could have on the development of organisms and the yield of many important farmed foods, such as, maize, wheat, rice, etc. This activity investigates the effects of global warming on a specific plant found in the local ecosystem under investigation.

Plants are put into categories according to their adaptation to water availability.

* ***Hydrophytic***- adapted to aquatic or semi-aquatic conditions. Rice is semi-aquatic.
* ***Mesophytic***- adapted to middle water conditions, typical temperate terrestrial conditions. An example of a mesophytic habitat would be a rural temperate meadow, which might contain Goldenrod, Clover, Oxeye Daisy, and Rosa multiflora. Mesophytes make up the largest ecological group of terrestrial plants, and usually grow under moderate to hot and humid climatic regions.
* ***Xerophytic***- adapted to conditions of low water availability. This includes plants from a variety of conditions, including sand dunes, high alpine habitats and equatorial deserts. Sorghum is a xerophytic plant. Sorghum is a genus of numerous species of grasses, one of which is raised for grain and many of which are used as fodder plants either cultivated or as part of pasture.
* ***Halophytic***- adapted to high salinity conditions, coming into contact with saline water through its roots or by salt spray, such as. in saline semi-deserts, mangrove swamps, marshes and sloughs, and seashores. An example of a halophyte is the salt marsh grass Spartina alterniflora (smooth cordgrass). Relatively few plant species are halophytes - perhaps only 2% of all plant species

***Exercise 1***

1. Inquire about the adaptations of a named plant, which grows in their local ecosystem. Depending on the ecosystem, the plant can belong to hydrophytes, mesophytes, xerophytes or halophytes.
2. Present adaptations of the selected plant highlighting key ecological words and compare in the class with other student teams selections in terms of plant adaptations and plant adaptation mechanisms.
3. Read the following passage about the adaptations of *Convolvulus oleifolius,* which survives in dry conditions, and then write on the dotted lines the most appropriate word to complete the passage.

Plants, which live in habitats where there is shortage of water, often have....................................... on the surface of their leaves, to reduce water loss by trapping a layer of still air around the leaf. This effect is also achieved by curling or rolling the leaves, so that the surface bearing most of the ............................................... through which water loss occurs, is on the inside. Leaves may also have a thick waxy ..................................................... to reduce evaporation. Another adaptation is for the leaves to have a ............................ by having narrow linear leaves instead of broad leaves. Plants with such adaptations are known as ..................................................... .

***Exercise 2***

A team of four to five students can be asked to inquire and write the methodology that they can follow to investigate the effect of temperature, or any other abiotic factor, on the development of a named plant that grows in their selected local ecosystem. The students should have the possibility to repeat observations over time, revisiting the same site and collecting data every day, every week, or even every month (or even every year). There will be a great variety of seedlings or seeds that can be investigated depending on the time of the season and the local ecosystem. The teacher should guide the team to plan their investigation with relevant questions, but without always providing the correct answers. Monitoring germination or growing of the seedling will entirely depend on team effort. This activity can also be linked with a visit to a local greenhouse. **The experiment can take place in the greenhouse investigating how a specific temperature affects germination of a stated number of seeds.** Students can experience hands-on design and installation projects using professional equipment and materials situated on-site greenhouse, which is dedicated to environmental sustainability.

**Questions**

1. **Identify a suitable dependent variable for your inquiry.**

* Measure of the growth of seedlings, e.g. surface area of leaves and/ or length of stem
* Number of seedlings germinated, if the investigation takes place in a greenhouse
* Statevariables, other than the temperature, or the independent variable in general, which may affect the growth of the named seedling?
* light intensity/ wavelength
* photoperiod
* type of soil / minerals {concentration and type
* humidity
* pH
* moisture of ground

**Other variables can also include:**

* oxygen concentration and carbon dioxide concentration
* age / storage of seeds
* genetic type / source of seeds
* density of planting the seeds
* volume of water used for watering the plant

1. **Suggest how each variable can be controlled or monitored.**
2. **Why scientists are interested in building greenhouses?**

Maintaining environmental control in the greenhouse can be demonstrated. For example, the need to control temperature, lighting, humidity, and even CO2 levels. Maintaining a balanced environment within your greenhouse will require the use of fans, venting systems, heaters, and monitoring CO2 levels. It is important to discuss the value of greenhouses for science/research and for the economy.

1. **How do you build a greenhouse?**

This question can link biology with chemistry / physics and technology. Construction and materials range from simple, lightweight materials, such as, PVC piping and a plastic covering for a cold frame style greenhouse that needs no heat. This question needs to elaborate framed construction and glass panels requiring venting and exhausts systems. Framing material may be PVC pipe, wood, or aluminum. PVC frames are not strong enough for areas that receive a lot of snow or high winds. Choice of covering material also needs to take into consideration the weather and seasonal extremes of your area

***Exercise 3***

1. **Describe what effect a non-controlled abiotic factor (variable) could have had on the results, if it had not been controlled.**