# EASY LESSONS IN SCHOOL GARDENS

## Features of Plant Life Made Real by Simple Experiments.

## AIMS, METHOD AND MATTER

### Of Agricultural Education in the Grades Illustrated by Work at State Normal.

We have learned that it will be an aid to teachers and an object lesson to readers who have followed these articles to show in some detail how the subjects hitherto treated may be adapted to school lessons. It has been suggested that most of the subject matter is too difficult for presentation to the younger pupils. This idea rests on a misapprehension. The work that has been given during the past three weeks in the state normal by the practise students teaching the first, second, third and fourth grades only, will show that the several topics of these lessons can readily be given in any grade, if pains are taken to present the subject matter objectively and from the standpoint of the child's knowledge and interests. The main subject is well treated in Hemenway's "How to Make a School Garden," and in Goodrich's "First Book of Farming." As an illustration of how the smallest children may be taught to make and to understand the school garden, the following outlines are given.

I. THE BEST SOIL.

Materials. Boxes containing black garden loam, clay soil, and sandy soil.

Aim. To teach and illustrate the different classes of soil.

Method. Distinguish by the touch the three different kinds. Then mix some of the sand with the clay to make a clay loam. Mix a large proportion of sand with the clay to make a sandy loam. Put some of each kind into a small bottle. Pour water on the top and note how long it takes the water to sink through each kind. Let each sample stand until it dries out. Observe which dries first and also the concondition of each after drying. Fill a small bottle with sand, another with clay. Pour in water from an equal sized breaker or test tube until each soil is saturated. Which holds the most water? Why?

Subject matter. All soils hold water. They are like reservoirs under the plants. The more water they hold underneath, say for three or four feet deep, in our country, the better they are. The less they evaporate from the surface, the better. Saturate two bottles of either sand, clay, or mixed soil. Cover one with an inch of dry dust or sand, and let both stand in the windows for a week. The uncovered one becomes quite dry, the covered one remains moist. What does this result teach about methods of retaining the moisture in our soil? If the soil is packed hard, the roots of the baby plant cannot breathe. If it is made loose and open by ploughing, digging, harrowing, etc., the spaces between the grains will hold air as well, as water, unless the water fills all the spaces. If this happens, the soil is made wet, not moist, and the roots cannot breathe. The air is forced out by the water, and the plants will be drowned. Some plants, however, like rice and watercress, can live in water. If the soil holds free water; that is, if it is wet and not merely moist, it must be drained. If it is so open that the water sinks through it, it should be partially filled with clay. What kind of soil is the best soil? Does our school garden contain good soil? Why? etc.

II. SEEDS AND SOIL WATER.

Material. A common table plate, a pane of glass, wet cloths wrung out from boiling water, and some seed beans.

Aim. To show how seeds absorb moisture from the soil.

Method. Wring out two cloths, moderately wet; place one over the bottom of the plate; put the seeds on this, cover them with the other cloth; put on the glass and set in a warm place.

Place a few beans upon a small piece of damp cloth or blotting paper. Cover them with an inverted tumbler, and put in the sunshine. After two days, the seeds are swollen to twice their former size. Why? What other materials have you seen swell when put into water? Why? Observe that the seeds in the plate have swelled most. Why? etc.

These results show that the soil must be moist, and that we must press it close about the seeds or plant roots in order to make them grow. The water passes up through the soil more easily when the soil particles are pressed more closely together; but passes downward more readily and is so lost to the plant, if the soil is loose, open, or gravelley.

III. WHY WE PACK THE SOIL.

Materials. Two fruit jars or wide-mouthed bottles, some soil, and several seed-beans.

Aim. To show that close packing of the soil is necessary after planting most of the larger seeds.

Method. Put some damp garden soil into each of the jars, and then lay some beans on the soil in each. Cover the seeds with about two inches of soil. In one jar, pack the soil down closely; in the other, leave the soil very loose. Set the jars in a warm place, loosely covered. In a few days, more of the beans in the packed soil will have germinated than those in the loose earth. The reason is that the seeds with soil packed closely about them absorb the soil moisture much faster than the others do, and therefore germinate sooner. It is often observed in the fields that grain has come up better in the spots on which the horses have stepped than it has elsewhere. Why is this? Gardeners often walk with heel to toe steps upon their planted seed rows, when in dry days the seeds are likely to be short of soil moisture. If rain falls immediately, the seeds may get too much moisture when the soil has been thus compressed. After planting the ground is often rolled or pressed with a board. What is this done for? If the plowed ground gets very dry at the surface, it should be pressed or rolled so that it can draw up water from the soil beneath. And this should be done whenever the seeds have to wait too long for rain. In dry countries, as soon as the seed has come up, it is best to loosen the surface of the ground with a rake or harrow; otherwise it will continue to draw moisture from the deeper ground to the surface, to pass into the air and here it will evaporate so be lost to the plants, and the deeper roots of the crop will be deprived of moisture. In dry weather, we should plant immediately after digging or plowing. Why?

IV. HOW PLANTS DRINK.

Materials—Several bottles, some stems of plants, and a piece of celery with leaves at the top.

Aim—To show that plants take in water through their roots and not through their leaves.

Method—Cut off some stalks of lucern close to the ground. Put the stems of several pieces into a bottle of water; place several others with the cut stems in an empty bottle; still others, with the leaves in water and the stems out. Next day, those with the stems in water are still fresh and upright; those with the leaves in water have wilted a little; and those standing in the empty bottle have drooped. What do these results teach?

Put the celery into water colored with indigo. At the next lesson take it out and cut the pieces across through the stems. Observe in what channels the indigo water has traveled up the stems—through the small woody or tough parts only. Weigh some green lucern. Then place it on the radiator till it dries. Weigh it again. Notice what weight it has lost. Compare the dry with the green lucern. What has the green that the dry has not. We learn from these experiments: (1) that growing plants need much water, and consist mainly of water; (2) that this water is taken in through the roots, goes up through certain channels in the stems, and evaporates from the leaves; (3) that the leaves do not take in much moisture; (4) that plants must dry the soil by taking out the water and evaporating it into the air. Will weeds use up the soil moisture if permitted to grow? Should all weeds be kept out of our dry soils, whether they are naturally harmful or not? Should anything but the crop be permitted to grow on the fields in dry countries like ours? etc.

TRANSPIRATION OR EVAPORATION.

Materials—A thin glass beaker, some fresh lucern and a bottle of water.

Aim—To show that plants give off water through their leaves.

Method—Put the lucern in water and compress the tops into the glass beaker. Place in the sunshine. In a few hours, the inside of the beaker will be covered with drops of dew. Explain. Cut off a sunflower near the root and fit a rubber and then a glass tube over the part that remains in the ground; half fill the tube with water. Presently the water will rise in the tube and overflow. Explain.

V. HOW PLANTS GROW.

Plant in moist sawdust in a box indoors some beans and Indian corn, and in good soil in a box some radish seeds. As soon as the plumules come about an inch above the sawdust, let each pupil in your section pull up one of the beans or corn plants and tell what he sees—what the stem and the root are like. When the plant starts to grow out of the seed, we say it germinates. One part, the stem, grows upward to the light; the other part, the root, grows down into the dark, the coolness, and the moisture. Have the children notice the root and the stem, to distinguish between them. Let each one pull up a young radish plant. Observe that each tiny, white root that grew from the seed is clothed with a downy fringe of hair that looks like the finest silk. It is these hairs that draw in the moisture on which the plant feeds.

Cut off a few young stems of plants just before the leaves have come out, and show the stems to the children, examine the buds; they are covered with winter scales to protect them from the cold. These scales are forced open in the spring when the water comes up from the roots to feed the young buds, which soon burst into leaves. The leaves are very important to the plant. They are like the lungs and stomach of animals. The plant depends for its vigor upon the health of its leaves. If the leaves are stripped off or injured, or eaten by insects, the plant cannot get its food, and the fruit will not ripen. Leaves must receive their full share of sunlight, in order to make the food of the plants. They should be protected from injury and should be kept abundant. When water comes up from the roots to feed the young buds the leaves make it into plant food. Hold up some leaves to the light and place narrow objects behind them. The sunlight shines through the uncovered parts, and it is the sunlight passing through the leaves that makes food for the plant—the starch of corn or potato, the sweet juice of the peach or apple, etc.

VI. HOW PLANTS FEED.

Materials. A glass of water and a teaspoonful of sugar or salt; or (better) a bit of camphor gum and a small bottle of alcohol.

Aim. To show that solid substances may be dissolved in water and that they do not evaporate, but are taken in with the water that is absorbed by plant roots.

Method. Dissolve the solid and then evaporate the liquid. The camphor-gum, the sugar or the salt will remain in the dish. What do these two facts of solution and drying out show? How many of you have ever seen the inside of a common tea-kettle? It is covered with a whitish stone substance that came from the clear water continuously boiled in the kettle. Most of it is lime, which is one of the plant foods. Some of it is potash. The water containing lime and other minerals (nitrates, phosphates, etc.) rises from the root through the stems, to the leaves. The leaves evaporate the water and retain the plant food. This food is changed by the sunlight into starch and sugar, which are the main food of plants. Burn some twigs, dry grass and leaves on a tin plate, and notice the ash that remains. It is the mineral substance that was in the water formerly taken in by the plant, etc.

VII. SEEDS REQUIRE AIR.

Material. Several small saucers or dishes, some glass tumblers, and a few grains of wheat.

Aim. To show that the seeds will not sprout nor the plants grow, unless they get plenty of fresh air.

Method. Mix up some good clay soil with water until it is soft and putty-like. Pack this soil into one of the dishes until the air is pressed out of it. Leave the same kind of soil loose in another dish. Put a few grains of wheat on the surface of the soil in each dish, and cover them about ¼ of an inch deep with loose soil on one, and packed soil on the other. Invert a tumbler over each saucer and put in a warm place. After a few days the grains in the loose soil will have sprouted; the others will not. What does this contrast teach about the need of soil air? Place some wheat grains in a saucer and half cover them with water; place others completely immersed in another saucer. Cover both with glass tumblers and set in a warm place. The uncovered seeds germinate in a few days; the immersed seeds merely swell. What has caused this difference? Rice seeds, the seeds of the water lily and of Indian corn may germinate under water. These require very little air, and enough for them is held in their seeds and in the water. The experiment with the pressed and unpressed wet sail shows that if the soil contains much clay and is packed too closely around the seeds, they cannot grow. Should the soil in which seeds are planted be kept wet or merely moist? etc.

VIII. TRANSPLANTING.

Materials: The young plants that have come up in the boxes filed with soil, in the schoolroom windows.

Method: Take up the young plant, soil and all, and without rough handling put it into plowed soil, in holes large enough to receive the roots and the earth as a whole. If the young plants are in flower pots, take out the entire mould of earth, by turning the pot upside down on the hand and tapping the base of the flower pot. Make the soil very loose and fine in the garden and plant in proper rows or beds. Pull out some of the young plants in the box where they must be thinned and show how the roots are broken off by so doing. Compare with the numerous rootlets on a plant from which the soil has been carefully washed away. Water the transplanted specimens and after the watering, cover the wet ground with dry pulverized soil. Shade the plants for a few days. In the case of trees, we transplant only when the leaves are off, either in the late fall or early spring. In the case of evergreens, just before they begin to grow in the spring. In digging, get as much of the root as possible without injury. Cut off any broken and mangled roots, also the branches to correspond. (Do not cut evergreens). Have the hole large and dip the roots into water or thin mud before planting. Put loose soil upon the roots and pack closely. Pour in water, add more soil and pack again. Repeat the packing next day.

In similar manner may be illustrated the care of the soil, the recognition and removal of weeds and harmful insects, the cultivation and irrigation of the crop. The radishes, lettuce, peppergrass and onions should be ready to harvest before school closes and should constitute for the children who reared them the basis of a school dinner—a sallad festival—with which to celebrate the work done in the school garden.

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