Occasionally during the hot summer, students would visit the site to water the plants and weed the area.

The winter proved to be intense and large amounts of snow were deposited on the plants from the parking lot. On one occasion a snowplow clipped one of the small crab apple trees. This provided an excellent opportunity for a grafting demonstration. One of the branches was successfully regrafted and bore fruit the next season.

In the spring, a brick border was placed around the path next to the school building. This provided a 20-cm perimeter in which to plant small flowering plants. The large trees were also bordered with bricks at this time.

It was determined that using grass as a ground cover would pose too many problems, so three types of ground cover were tried as substitutes: ajuga, bugleweed, and variegated grass. Each was chosen because it required little or no maintenance. Bugleweed, with its white and pink flowers, proved to be the most popular and the most successful. As it grows it will be transplanted to other areas of the arboretum.

When the soil was turned to plant these new cover plants, some changes were noticed. The soil was moister and contained a greater quantity of humus. This was due primarily to the use of generous quantities of Michigan peat moss. Also, earthworms were found in abundance in each shovelful of dirt.

A change was noticed in avian life. Previously, starlings had been the only visitors. Now many types of sparrows frequented the location. Robins, chickadees and hummingbirds were sighted.

To encourage the bird population, a feeder was set up near the Crimson King maple. Sunflower seeds were used as food. One result of this was the growth of bird-planted sunflowers in the area. This fall many of the sparrows could be observed tottering on top-heavy sunflower plants attempting to extricate the seeds.

Next spring, we plan to try another type of ground cover. Myrtle, supplied by the assistant principal, will be grown on test plots in the area.

Late this fall, the Ecology Club undertook a bicentennial project. Red, white, and blue tulips were planted in a flag-shaped pattern. In the spring we will see if the plants are dense enough and if they will bloom simultaneously to produce a flag effect. The flag pattern chosen was one of the early types, with red and white stripes, a blue background and a circle of thirteen white stars.

Another project for the future will be labeling the plants with their common and scientific names. A demonstration of the principles of grafting and pruning may be tried using either the crab apple trees or the maples. Some of the smaller shrubs will be used to demonstrate the principles of vegetative propagation. Students working on this project will be allowed to take the cloned plants home if they like.

The benefits from this arboretum project have been many. It has given students a firsthand experience in botany. Although Akron is a rural school district, many of the students had never planted anything. It has given students a firsthand insight into the reasons for use of soil conditioning products such as peat moss. It has beautified a formerly desolate area of our school environment and has given the biology classes a small area of green earth where plant growth experiments can be carried out.

All too often what is taught in the classroom has little practical application. This arboretum has allowed the correlation of material on plant maintenance taught in the classroom and work with actual specimens. Some principles of geometry were also incorporated during the initial planting of the area.

Classically, arboreta have served to preserve plant varieties, to display them, and to provide an area for botanical experimentation. Our arboretum serves the same purposes on a smaller scale. It is hoped that the project has given students a greater appreciation of plant life.

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CUSTOM LABORATORY EQUIPMENT MADE FROM ACRYLIC PLASTIC

Acrylic plastic is useful in making a variety of custom equipment for biology laboratories. We make this statement based upon five years' experience in designing and fabricating acrylic plastic apparatuses and models used in a general biology program at Ball State University, Muncie, Indiana.

Acrylic plastic is available in a variety of colors and types (sheet, tube, rod) and is readily cut, drilled, heat-formed and solvent-joined. The Rohm and Haas Company (Independence Mall West, Philadelphia 19105) has a booklet available, *Do It Yourself with Plexiglas,* which includes a section concerning fabrication of acrylic plastics.

Materials and Methods

A minimum of specialized equipment is required to work with acrylic plastic; the basic supplies can be purchased for less than ten dollars and include a Plastic Plus cutting tool, Weld-On 3 solvent cement, Weld-On 16 thickened cement, Hypo-RH 200 solvent applicator or a disposable hypodermic syringe and needle. A circular saw and hand drill are useful in some applications; a strip heating element is necessary to heat-form acrylic plastic.

Standard thicknesses of acrylic plastic can be cut by scribing and breaking. This procedure is easier and the results are more uniform than for glass. Acrylic plastic can be joined with a variety of colorless solvent cements; a special thickened cement provides high strength joints capable of withstanding a range of temperatures.

Discussion

Four of our acrylic plastic models are illustrated in figure 1. All four can be readily fabricated with a minimum of equipment and none require heat-forming.

The models at the left in figure 1 are an air inversion column and chemical smoke generator used to illustrate the effect of temperature stratification on the dispersal of air pollutants. The air inversion column was fabricated from 10.16-cm and 15.24-cm outer diameter acrylic plastic tubing joined with thickened cement to a base of 3.18-mm sheet acrylic plastic. The joints are very durable and can withstand ice being placed in the outer tube to cause temperature stratification within the column. The support-reservoir of the chemical smoke generator was fabricated from sheet acrylic plastic joined with thickened cement.

The remaining equipment was also fabricated using sheet acrylic plastic joined with solvent cement. The greenhouse model (figure 1, center rear) is used in conjunction with a visual display to explain the atmospheric carbon dioxide greenhouse effect.

The plant chamber (figure 1, right) takes the place of an expensive glass bell jar. An added feature not available on glass bell jars is a small entry port that can be connected to a gas-generating assembly for special treatment of confined plants. The port can be closed with a rubber stopper after treatment. This apparatus is used to display a plant treated with sulfur dioxide gas. The display chamber can be temporarily sealed with Vaseline at the rim of its base during treatment and display to prevent the escape of irritating gas.

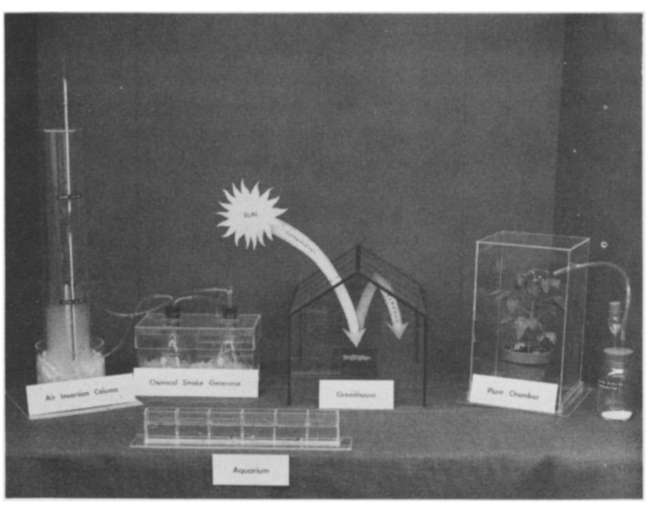

Fig. 1. Biological display models fabricated from acrylic plastic. Photo by R.W. Olsen.

The sectioned display aquarium (figure 1, center foreground) has interior dividers with a row of small holes to equalize the water height within the sections. It is much easier to observe genetic traits transmitted to guppy progeny when each guppy is confined to a single compartment rather than all being grouped in a large display aquarium.

The novice fabricator should be pleased with the results obtained using acrylic plastic. It requires a minimum of specialized equipment and supplies, very little work space, and is low in cost compared with commercially available scientific-educational supplies. Fabrication is relatively easy and features unavailable on commerical products can easily be incorporated. Custom instrumentation can be designed and fabricated. The material is durable, easy to clean and maintain, and is transparent, offering excellent visibility for student observation.

It may be less time consuming to design and fabricate a model to meet a specific need than it is to review several scientific-educational catalogs to identify whether a commercial product is available. The novice fabricator can rapidly advance to exploring the wide range of capabilities acrylic plastic offers, from heat-forming to the use of more expensive bronze transparent plastic (solor control tints) for energy-related experimentation.

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A THREE-DIMENSIONAL CELL MODEL

Each year I notice that few of the tenth grade general biology students seem to comprehend the fact that cells are three dimensional. This is mainly because most of the diagrams in their text illustrate only a flat cell, regardless of the type of cell it is.

This year I designed a laboratory that seemed fairly successful in helping them to visualize a three-dimensional cell with a minimum amount of frustration and a maximum amount of student participation.

I placed two small plastic Baggies one within the other to simulate the two-layered plasma membrane. This double bag was then filled with a gelatin solution containing sugar, salt and some oil. The Baggies were tied at the open end and randomly pricked with a pin in five to six places, piercing through both layers.

Each team of four students was given a Baggie "cell" and told that it represented a cell and they had twenty minutes in which to find out all they could about it.