

Science Club Studies a Shopping Center

By KENNETH N. SELLATI

One of the extracurricular responsibilities of a secondary-school science department is to sponsor a science club. The character, vitality, and goals of the club depend to a large extent on the attitudes and philosophy of the faculty moderator. The club can be an academic albatross or an exciting challenge: it's the moderator's choice.

The usual agenda for such clubs includes field trips, career studies, films and lectures, and perhaps individual research projects, which usually are associated with science fairs. The addition of an all-club project related to the environment may be beneficial.

For the decade of the 1970s the word "environment" is vital. The theme usually engenders a strong

academic and civic response regardless of one's social and economic background. Students with a variety of scientific interests and experiences can be brought into harmony by working on a single, comprehensive environmental project. If the program is properly designed it will stimulate greater scientific curiosity and enliven civic interest.

The environment of most American students is urban or suburban. American cities, a major part of the environment, are constantly changing their functions—providing environmentalists with fresh avenues of study. The Columbus High School (Miami, Fla.) Science Club began with the question "What are the environmental effects of a shopping center?"



Fig. 1. Busy intersection: S.W. 24 St. at S.W. 87 Ave., Miami.



Fig. 2. Westchester segment of the shopping complex before the business day begins.

Westchester Shopping Center

The focus of the suburban world is the shopping center—an island usually surrounded by a sea of low, boxlike dwellings. American shopping centers are a microworld of asphalt, cement, plastics, and wildly colored neon lights tempting cars like a light bulb attracting moths. These synthetic islands cater to the citizen's daily social and economic needs and thus reduce his dependence on the classical urban structure. Metropolitan Miami is typical of urban sprawl with its casual assortment of satellite shopping complexes. One of these, located in southwestern Miami, is called Westchester Shopping Center.

Westchester contains 127 shops, ranging from newsstands to large department stores. It has 548,640 m² of asphalt and 187,000 m² of cement. The parking lot can accommodate 4,100 cars, and the center is served by three bus lines. At the height of business (for example, Christmas week) each parking space is used 10 to 12 times a day.

Aerosol and Temperature Studies

The students could ignore the water and sewage

aspects of the problem, because the shopping complex receives and discharges its liquids by underground pipelines. Thus the study was narrowed to the shopping center's role in atmospheric aerosol and thermal pollution and its effect on the flora and fauna.

In order to study the aerosol aspects of the problem, 24 one-gallon, wide-mouthed jars were placed on single-storey rooftops from the center of the shopping complex to a distance of 1 km in four directions. Each jar contained 500 ml of distilled water and was covered with window screening in order to prevent large objects from entering. Once a month the jars were studied in the lab. Information about pH and dry residues was recorded. The Dade County Pollution Control Board provided chemical data beyond the investigators' means.

Temperature studies were important to the program: they would help to calculate the energy budget of the Westchester center and provide indirect evidence about atmospheric pollution. The shopping center, being composed of asphalt and cement, emits (especially at night) great amounts of radiant ener-



Fig. 3. K-Mart segment of the shopping complex shortly before noon.

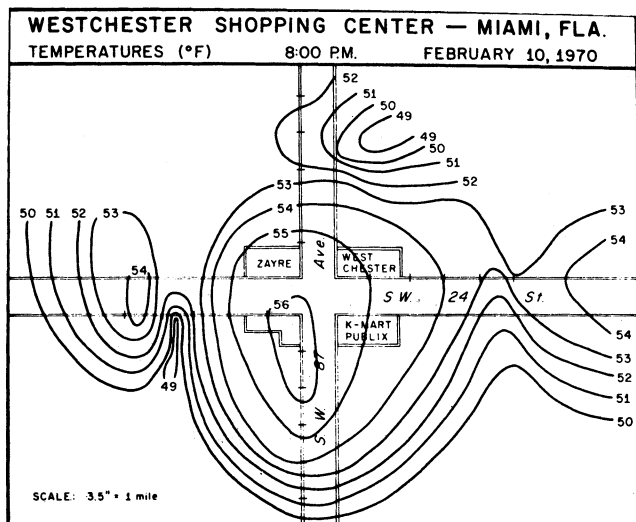


Fig. 4. Isotherms of the Westchester shopping complex and vicinity at 8 p.m. on 10 February 1970.

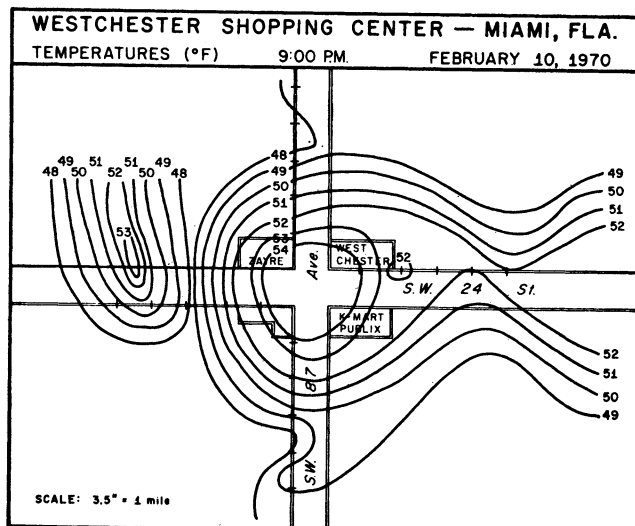


Fig. 5. As in fig. 4 but one hour later—9 p.m.

gy, which energizes aerosols and thus magnifies atmospheric pollution. To measure temperatures Taylor alcohol thermometers were used, for accuracy. Specific weather conditions were required for the temperature survey. Winter in southern Florida is the ideal time: cool, dry, descending air, low variable winds (less than five knots), and rapid surface cooling would magnify Westchester's thermal radiation.

On 10 February 1970 the atmospheric conditions were ideal. At 7 p.m. students received calibrated Taylor alcohol thermometers. Starting from the center of Westchester and moving outward in four directions, students were spaced approximately 300 m apart for a distance of 1 km. From 7:30 to 9:30 p.m. temperatures were recorded every 10 minutes. This information would provide a series of horizontal isothermal maps. At the same time four teams, each with Taylor thermometers attached to weather balloons 25 m above the commercial complex, moved about the shopping center every 20 minutes, collecting data for a series of vertical isothermal maps.

During the two-hour survey five students counted the cars in motion; 1,100 to 1,200 were noted. The literature of air pollution provided data about the emis-

sion rate of cars traveling within the speed limits. Two jars, four thermometers, four balloons, and a jaywalking ticket represented the cost of the evening.

Findings

From the data the following general statements can be made:

1. The shopping center is a primary source of nonheated aerosols. (Automobile movements stir these high into the air.)

(Concluded on p. 137)

The author has been studying the natural history and cultural history of southern Florida and the West Indies since his secondary-school days and in the past two years has contributed seven articles on these subjects to the *Miami News* and *Muse News* (publication of the Miami Museum of Science). He has taught biology, other sciences, and world history in Florida secondary schools since his graduation, in 1961, from the University of Miami; since 1967 he has been at Christopher Columbus High School, 3000 S.W. 87 Ave., Miami 33165. His special interests include the cultivation of orchids and bromeliads; chess; and flying.



Fig. 6. Students prepare to attach thermometer to weather balloon in order to collect vertical temperature data.

all the right answers indicated. When discussing the exam with them, this saves the time of going over those questions that many students will understand by just seeing which answer was correct. The time saved can be used to explain in more detail an answer to a more complex question. Our exam-review sessions have been far more rewarding because of this feature. Usually the questions that are in need of detailed explanation are those that confused the largest number of students in the class; hence, these explanations reach the greatest number of students who need them.

4. For reviewing at the end of marking periods or semesters the student has all the correct answers already on his answer sheet. A set of exams becomes, in effect, a sort of "programmed" biology course. This will encourage the student to go over his own exams, knowing he has a ready check on his knowledge.

We have been using this system in our biology department for several years. We have found it easy to use and very rewarding. Those who try it will, I am sure, be similarly rewarded.

Science Club

from p. 133

2. The major gas and heated-aerosol polluting agent is automobile exhaust.

3. Under certain conditions automobile exhaust may combine with water and produce weak but effective acids. Thus, corrosion of metals occurs at a greater rate.

4. The shopping center is a major secondary pollution factor, in that asphalt and cement radiate heat, which magnifies existing pollution.

5. Architects and engineers should consider the use of materials that are less heat-retentive. This would reduce some aspects of air pollution.

6. The immediate environs of the shopping center are warmer on cool winter evenings than are the streets farther away. The thermal energy from the shopping complex is effective slightly beyond the 1-km zone.

7. During the summer months rainfall patterns indicate that the high aerosol content and additional atmospheric heating over the center creates an almost constant vertical movement of air. This causes convection showers around the center and a lessening of rainfall over the center.

The biologic studies yielded less information, but the students found that domestic species of plants and animals quickly replace native species. Pesticides and other chemicals probably aid in the removal of native populations, and the more resistant domestic species increase.

The project raised more questions than it answered. Even so, this project proved to be a source of enrichment to the club and the community.

War on Nature

from p. 130

Despite his misguided stand on Alaskan oil, Hickel is a man who has shown great capacity to learn. I wish him well. I hope that he will learn all the ecology and biology that he must; for his is an important voice, which has given both students and biologists, as well as the public, faith that even this government might possibly work or might even change, given an honest man. Abraham Lincoln was made of similar rough stuff, and he became a great president.

We will never get to the root of our environmental crisis by picking up tin cans. Only by changing the very institutions that have allowed our crisis to develop, by placing in high government office men who have an honest concern for ecology, is there hope for plants and animals, and for us, to survive. Let us quickly dismiss from positions of power those who do not understand the ecologic limitations of the earth. Let us replace them with people as environmentally concerned as Ralph Nader, William Ruckelshaus, Gaylord Nelson, Walter Hickel, and Robert Packwood. And let us, as individual biologists, do our utmost to make sure that such men are elected to the highest positions in government.

Let the biology teacher become politically active. Let him join with the Sierra Club, the Environmental Defense Fund, the Wilderness Society, the National Parks Association, and any other organization willing to hire lawyers and fight the smoke screen of the anti-environment campaigns.

The National Association of Biology Teachers must speak out, too. It should hire representatives in Washington—eco-lobbyist lawyers who would represent its members' wishes (Iltis, 1969, 1970b). The issues are not only questions of politics or biology; they are issues of simple human decency. The biology teacher, more than any other professional, has the answers to many of today's problems. You must not remain silent.

(To be concluded in the April issue)

Correction

In the article "A Versatile Copper Reagent for Sugar Chemistry Demonstrations," by F. W. Price (ABT 34 [1]: 23-27) the word "ammonia" was dropped at the beginning of the section on preparing the reagent. The first sentence should read as follows: "To a 5% w/v [weight per volume] aqueous solution of cupric sulfate pentahydrate, $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, add strong ammonia (S.G. 0.880) from a buret with continual swirling."