

DOCUMENT RESUME

ED 156 507

SE 024 485

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 TITLE Case Studies in Science Education, Booklet IX: School Science in an Eastern Middle Seaboard City.  
 INSTITUTION Illinois Univ., Urbana. Center for Instructional Research and Curriculum Evaluation.  
 SPONS. AGENCY National Science Foundation, Washington, I.C.  
 PUB DATE May 77  
 CONTRACT NSF-C-7621134  
 NOTE 36p.; For related documents, see SE 024 476-491

EDRS PRICE MF-\$0.83 HC-\$2.06 Plus Postage.  
 DESCRIPTORS \*Case Studies (Education); Curriculum; \*Educational Research; Educational Trends; Elementary Secondary Education; Field Studies; \*Instruction; \*Mathematics Education; \*Science Education; \*Social Sciences  
 IDENTIFIERS \*National Science Foundation

ABSTRACT

This booklet is the tenth of a series of 16 booklets that together describe and present findings for a study which involved field observations and a survey of science teaching and learning in American public schools during the school year 1976-77. The study was undertaken to provide the National Science Foundation with a portrayal of current conditions in K-12 science classrooms to help make the Foundation's programs of support for science education consistent with national needs. Eleven high schools and their feeder schools were selected to provide a diverse and balanced group of case study sites. One field researcher was assigned to each site and instructed to find out what was happening and what was felt important in science (including mathematics and social science) programs. The case study report from the "Archipolis" site - an Eastern middle seaboard city - is contained in this booklet. (MN)

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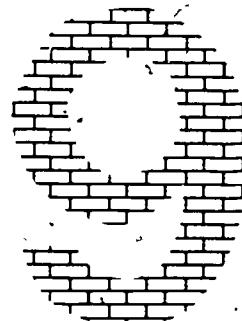
Case Studies in Science Education  
A project for the National Science Foundation  
conducted by CIRCE and CCC  
270 Education Building  
University of Illinois at Urbana-Champaign

BOOKLET IX

SCHOOL SCIENCE IN AN EASTERN MIDDLE SEABOARD CITY

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Urbana, Illinois

May 1977



Our charge and our intent was to study science education. Often the science story seemed to shrink to insignificance beside other stories of teaching and learning in the schools.

It was not unusual to hear a teacher say something like:

*He's not a bad boy, and his family does care. I think the three of them just got into something. Anyway, I told him I was sorry it had happened, too. And I was glad about the apology. . . . It is so hard, though! They aren't bad children. . . .*

It could have happened in any of our sites. But in Archipolis it happened so often! The weeks were strings of confrontations and reconciliations, beaded with smiles, taunts, curses, and embraces of one form or another. Most of the time adolescents and adults treated each other with warmth and openness. But exuberance and disregard for authority brought confrontation. At BRT, perhaps once a year in the whole school, a youngster might openly defy a teacher. In Fall River each teacher might expect such a disturbance sometime during the semester. In Archipolis, much, much more often.

Perhaps part of the reason is that the disciplinary system is inconsistent. Perhaps part of the reason is that the stated expectations for student learning are unrealistic. The reasons are not clear, and this case study will not explain the disparity between the code of behavior adopted by the schools and the actual behavior. What is crystal clear is that the confrontations sap the energy and consume the time that should be spent on lessons.

Such problems are not the sort of thing a school system likes to put on display. Observer Jacquetta Hill-Burnett was not warmly welcomed into the Archipolis schools. But the concern was for the safety of a young woman perhaps unacquainted with the ways of the city. When she told of her years of work as an urban anthropologist, they were not persuaded of the wisdom of her career choice, but they generously consented to her visit--hoping, we are sure, that the airing of distressing problems would win support more than censure.

"The worst is over." "We got it turned around."  
"We're doing pretty well under the circumstances."  
And they were. The circumstances were debilitating. Lab materials, textbooks, and demonstration equipment were inadequate. The teachers were capable enough in academic mathematics, but not able to overcome the obstacles to classroom learning. The "back-up system" was thin--when someone was unable to do the job, no one automatically slipped in to fill the breach. (When the nurse was not on station, a foot showed up on the high school principal's desk for removal of a splinter.) The more able students.

Perhaps too much is being said too soon. Better to get it directly from Field Observer Hill-Burnett.

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The people in the schools of Archipolis are not at ease with the day-to-day conditions of work and study in the school, judging by observations in one school district of that city which serves a relatively large proportion of poor in its constituent population. The personnel in the school are under duress. The organization they work in has been severely affected by budget cuts; loss of student population; materials distribution problems; court decisions that enforced equalization of teaching resources, but introduced guidelines contradictory to those of federally-funded programs; court decisions that forced mainstreaming of all kinds of students; the general poverty and high unemployment rate of the parental constituency of the public schools; ~~the high crime rate of the parental constituency of the public schools~~, the high crime rate, particularly vandalism and theft, that is often a counterpart in urban settings of those economic conditions; and by a system heavily dependent on federally-funded special programs characterized by short-term abundance followed by reduction; squeeze-out and pull-out for national, rather than local reasons. Some of these problems are more salient than others in school peoples' talk. Some of the stresses are wretched puzzles to which they have no solution, and about which they feel hopeless. Many people in the system seem not to feel the stresses to the same degree. The principals suffer the pressures of middle positions, facing in several different directions and, thus, often not viewing or being able to view things from the same perspective as the teachers. But teachers are particularly burdened and particularly desirous that the very difficult circumstance of their work situation be candidly and honestly reported.

The corpus of data on which the research is based consists of data from four and one half weeks spent on interviews and observations in five schools with teachers, students, administrators, and support staff (counselors, hallguards or principals' aides), and in the homes of some parents. The reading, writing and lesson materials were important "artifact" data. On an extemporaneous basis I also interviewed taxi drivers, bus drivers, gas station attendants, store clerks, and city government officials. The daily newspaper was another important source of city-wide information on schools. I reviewed demographic and statistical data on the school system available in the offices of the board of education as well as reports and studies done on the school system by outside agencies, including private agencies.

In order to manage highly distilled reports of ethnographic case studies with coherence, one must emphasize perspective and theme, rather than wide-ranging detail. The reader must take account of the bias introduced by virtue of using a selective perspective from which to present this summary account. In this case, that perspective is a simple one that revolves around the question of what it takes to carry out a given activity, or set of activities, in certain ways to accomplish certain purposes. This means one considers intentions and wants, i.e., people's purposes, as well as the resources of time, space, materials, information, and social relations necessary to conduct activities in certain ways. If science in schools is viewed as a kind of activity in which certain people participate, then it is seen as actions of individuals which require certain kinds and amounts of materials, certain allocations of time and space, and certain meanings being attributed by participants to the actions and materials. Part of the meaning

comes from people's purposes. It comes from what people want and what they want the activity to accomplish. Other aspects of meaning attached to activities come from past experience, particularly including experience with social groups and their shared meanings. As they do for any other activity, participants have views on carrying out science activities in certain ways.

The science curriculum, then, may be thought of as a kind of activity, or a subset of activities, that takes place in the context of many other kinds of human activities comprising the organization known as school. In this study the National Science Foundation specified which kinds of activities were going to be counted as science: activities with knowledge content of physical science, biological science, social science, and mathematics were to be the object of the research. By implication, activities that did not include at least some of these knowledge features were to be regarded as "not science" for purposes of the study. Because, however, other events or activities might have bearing on science activity so defined, other activities and their conditions could not be ignored. Indeed, the district locale and school locales of this ethnographic case study in Arhipolis were deliberately selected to look at school science in a setting that included a large proportion of low-income people in its constituency.

#### MULTIPARTITE PERSPECTIVES

Using the activity paradigm to approach the study of school science showed, not surprisingly, that the nature of science activity varied depending upon the level of the grade system one looked at. The relationship among the various types of science--mathematics, physical, biological and social sciences--varies not only by elementary, by junior high, and by high school level, but also from school to school of the same level, depending upon conditions such as student behavior, allocation of resources, district program thrusts, and some complicated relationships to the constituent populations of the school in question. Events and conditions look different from the point of view of different sets of people in different segments of the school system. Different views of issues arose from the roles of student, teacher, and administrator. Differing perspectives arose not only at the different grade levels of elementary, junior high and high school, but also from local office, to district office, to central board offices. Parents may be thought of as an adjunct or tangential part of the system. With views different from, as well as overlapping, other segments of the system. While community is often thought of as a residual segment, in this case agencies such as child welfare, police, and health agencies are salient components of that category. The emergence of the courts as a significant participatory segment is a portentous development for most urban school systems, and particularly for this one. The courts can no longer remain an undifferentiated part of the community in relation to the school. Thus the courts and service agencies were forces emerging out of that residual community sector that had gained power and salience in the schools, and with whose impetus school people were now trying to deal.<sup>1</sup>

<sup>1</sup>One of the empirical drawbacks of a short-term study is the lack of time to check out events and issues from the various views from various postures in the system. Differing views often form patterns, even contradictory and contrasting ones, that make sense of variety in the processes of the system. While this report is weak in reflecting properly the multifarious points of view and interpretations and accounts of events and issues that are part of this complex system, in so far as different perspectives can be reported, they will be noted with as much accuracy as was possible, given the restraints of time.



The interviews which began with junior and senior high science teachers turned up the widespread view that in the elementary school, the amount of science activity and the way science activities took place is very much dependent upon the characteristics of the teachers. (They believed) students' experience with science largely depended upon the classroom teacher's individual background in science, and confidence in doing scientific activities and in doing scientific thinking. Yet, interviews with junior high students revealed that they didn't necessarily see their contact with science in school as limited to their classroom teacher's predilections, but often remembered visiting "teachers." Some contacts came regularly and some came from time to time. Students often recalled special science events and programs: particularly here, a science field-camp. This perspective (from several students) brought into focus the question of a history of the process of providing supplementary and supportive personnel for science activities. The issue had wide-ranging ramifications and connections. It was viewed differently not only by school level, but also by position in the hierarchy, from student to teacher to the higher levels of administrative staff and the central board.

From the teachers' point of view, before the "decentralization plan" had gone into effect, the central board of the school system had provided "department" (translate that subject-matter) specialists to go to local schools. Their activities and functions had varied somewhat from elementary, to junior high, to high school. At all these levels, the teachers now expressed some sense of loss about those functions. They still dealt with the district office for support personnel; but the support personnel were no longer categorized by subject, or "departmental," specialization. They further saw the process of securing help from these personnel as a question of new competition for resources, perhaps challenging budget priorities in the local school. The personnel of the central board office did not see the history of the arrangements for subject specialist support in the same way at all.

From the point of view of some personnel at the central office, curriculum development and decision-making had been too centralized and too narrowly based. In order to place responsibility over support resources closer to the teachers, a number of reforms took place. Among these was locating support specialists in district offices and discontinuing organizational boundaries based on subject matter. The decision about when to call the support service was transferred to the local school and the teachers in it.

The teachers and principals seemed to appreciate the effort toward decentralizing decisions and responsibility. But the new system also left unfilled certain functions performed by the old system. The high school teachers missed the information resource service that central subject-matter figures had readily offered. If a question had arisen in the past, one knew not only where to call but also whom to call. The specialists "dropped by" with news of new curriculum materials. The elementary and junior high teachers recalled that teaching materials used by the specialists in demonstrations were then left to be used at the school. After decentralization, the teachers missed this extra resource. (One might conjecture that all did not benefit equally in this dispersal. But that is another issue.)

Finally, the elementary teachers saw priorities in decisions about resources as integral to the new arrangement. In their view the allocation of funds to science specialists now had to compete with other activities in their schools. The reality at the elementary level was that science activity was in competition for time, space, and budget with other subject activities more closely associated with the idea of basic skills. Social studies benefitted somewhat because of its use as content for the exercise of reading skills. But in a "money crunching district" (as one junior high principal described Archipolis) and in these money-crunching times, the competitive position of physical and biological science has become marginal in the elementary school. Just "how marginal" is only increasingly clear as one locates other factors adding to the competitive intensity.

*Actually I really enjoy science. But I haven't had the time, with all the other things to teach, to put time into developing a science activity. Actually the children enjoy it. We sent the children to the environmental lab and they came back bubbling. EPA puts it on. But with the press of other things, I just couldn't take up on that.*

The teacher quoted above went on to say the Equipment/Media Center would be an excellent place for science projects. In this instance, lack of time resources, not lack of material resources was said to prevent physical and biological science from becoming a regular part of the curriculum. By contrast, in the elementary as well as the junior high schools, mathematics enjoyed a competitive advantage because of its association with basic skills. Mathematics, along with reading, received extra support through Title I funding for hiring remedial specialists to work with children at selected grade levels.

Mathematics, or arithmetic, seemed to be part of the daily routine of all the upper-primary grades I saw. It was also part of the routine of the lower primary teacher I visited (she taught first, second, and third grades). On the wall was a chart on ordinal numbers that (she explained) was part of first-grade mathematics. I asked her about the view I had heard expressed by junior high and high school teachers that elementary school teachers don't really work on mathematics, unless they happen to like it. She replied:

*Oh, but I can't see how any child can leave elementary school without knowing how to add, subtract, multiply, and divide, at least with whole numbers.*

She went on to explain (paraphrased from recall):

*Some teachers we have are afraid to teach mathematics. They don't know enough about it, so they used to rely on departmental resource people. Now they have to rely on themselves more.*

Competency-based curriculum objectives were being introduced actively throughout the school system, in part to assist teachers who "now had to rely on themselves more." A manual of objectives of skills and of knowledge for all the subjects and all school levels was being developed and distributed by the central board offices. Teachers' meetings were being held to plan local school programs and efforts that would realize the objectives. For example, in a given school, physical science teachers and social science teachers formed separate work groups, each of which took the list of skill and knowledge objectives from the manual of competency based curriculum objectives and discussed the constructing of lesson plans and teaching materials that would realize the competency goals. The physical science and social science teachers seemed subdued by the enormity of the task before them. Mathematics teachers and English teachers seemed more comfortable with the undertaking. They were using previously developed standardized, criterion-based, diagnostic tests to locate "weaknesses." As one elementary teacher explained to me, mathematics tests are given in October and they ". . . get results; we build our work around that, and then they [students] are tested again in April . . ." Thus, elementary and junior high school teachers saw the skill and knowledge objectives already translated into diagnostic tests, and set about using them in that way. They felt they could quickly find out where the children were among skills and knowledge competencies, and thus could efficiently organize lesson time and effort around accomplishing specific competency objectives.

Poor literacy and inadequate reading skills were constant concerns and objects of teacher complaint through all grade levels, for all subjects--math as well as physical science, and most pointedly, social science. Grade school teachers emphasized that reading and social studies must begin close to the daily experience of the children. They said that many media of "taking-in" information--film, tapes, pictures--must be used together to provide a more meaningful context for reading. I asked about claims by junior high and high school teachers that learning to read is often not being accomplished in

elementary schools today. The elementary teachers emphatically insisted that teaching children to read is a never-ending process. Children don't just learn to read for all subjects for all times. These teachers countered with the contention that upper level teachers often want an easy time of teaching, throwing a book to the child and having the child do all the work. They do not see the high school teachers employing various media and methods to teach students to read new content areas with understanding.

Many, but not all, junior high school social studies teachers and most senior high school social studies teachers regard the developing of reading skill as necessarily prior to learning social studies. One junior high teacher expressed the view this way: "Let's be honest about what we are doing. If we are teaching reading, let's call it teaching reading, not social studies."

In their staff discussions, junior high social studies teachers, too, acknowledged the "motivation" potential in using the everyday life of the student to teach about social studies. They faced a motivation dilemma with poor children from minority areas of the city. An older teacher with many years of experience declared (paraphrased from recall):

*Sure, I can teach the social studies of the ghetto, and limit their words to the jargon of the street. But what are they going to do when they meet the wider world beyond the street? How are they going to talk and what are they going to talk about?*

The pedagogical reality says "Use the material of their daily-life." The political reality of the ethnic group says, "Dare you, if you care what happens to them?"

Perhaps one never senses how basic the basics are until one tries to teach a group of students, many of whom are without the basics. In junior high math classes Miss Matlan found children who "did not know how to add and subtract, let alone multiply." She told me that one can't just "naturally" teach someone who does not know how to add and subtract, the fundamental understandings of arithmetical processes. Remedial teaching was, to her, a real and difficult skill that one had to be trained to do. She displayed profound respect for the ability of elementary school teachers who know how to teach the fundamental skills of adding and subtracting. Miss Matlan was teaching seventh- and eighth-grade classes, except for her home room, and ninth-grade class. One could describe the kids in ninth-grade class as "kids with big problems with their basics." Some who aren't so bright and others who are bright are so heavily into the "street" system of social relations and so under peer-dominated social control that they are lost to the activities of the classroom. After observing this group in class, I would venture to say that judging accurately the intellectual character and potential of children in a class like this one is not easy. The force of the social behavior in the situation is so pervasive that divining how certain students might behave intellectually, were classmates behaving differently, is more flight of fancy than diagnosis or prognosis. As I watched Miss Matlan teach math to this ninth-grade group, my respect grew for her skill at maintaining work-oriented social organization. With decided interactive and verbal skill, she kept an essential control without stifling the students. She also kept them working at their math assignments. The kind of physical and emotional effort her skill involved simply cannot be appreciated fully by those who have never had to deal with this kind of social environment for teaching day in and day out. Miss Matlan works for developing understanding of concepts underlying the meaning of what they are doing. For example, she insists that their math papers carry a topic title, a symbolic label for what they are doing. Sometimes she has them write out in prose the sequence of operations they are following, the relationships among the components of a concept, or the rules governing operations.

Not everyone would be pleased with Miss Matlan's teaching, or with the other math classes of this urban community. Different people see insights pursued and opportunities missed. These are some of the many multipartite perceptions in this complex situation.

#### TEACHING SCHOOL SCIENCE

Teaching science-as-inquiry through discovery, or learning science by doing what scientists do, was not widely practiced in the classrooms I observed. Of course, teaching science-as-inquiry does not require that it be taught by a discovery approach. If a teacher teaches that science is tentative and flexible and how scientific ideas are generated and tested, so that his/her students deal with scientific knowledge from these perspectives, then surely, by whatever means, a teacher has taught the students to understand science-as-inquiry. Nevertheless, the most ubiquitous emphasis that I saw was teaching about "what is known" through concepts, the standard labels, the meaning or definition, context, and the significance. Although the discovery approach was given wide verbal credence, only a few science teachers employed it regularly in their classes. Even they did not employ it with all classes. Discovery learning--whatever its final payoff for understanding science--is difficult to employ from the point of view of materials resources, self-directed social organization by students, and reliable sequencing of day-to-day classes. The subsequent discussion will show how the social context can hamper and prevent the use of such an approach on a regular basis, and may favor other approaches to the teaching of science in some schools.

In two different junior high school settings, a seventh-grade "astronomy" lesson and a ninth-grade social studies lesson, I saw deliberate and thoughtful emphasis on how anybody, including scientists, might come up with ideas about how things are, how one formulates ideas about them, and how one explains them. In Lincoln Junior High School, Mr. Nicollet started the discussion with the question:

*How many saw Venus last night? Who wants to draw where they saw Venus? (He gets two quick volunteers) . . . What was the phase of the moon?*

Three students drew their observations on the blackboard. They compared their representations with each other and with sketches other students made. Questions arose about the nature of the phenomena of moon phases versus the question of how to represent accurately what is happening. They agreed, with the participation of the teacher in the discussion, to observe and record their observations once again that night in order to answer some of the questions raised in the discussion. Further discussion followed, reaching questions about the solar system and exploration of outer space. Mr. Nicollet introduced material from the text book, then said:

*Look, this book is out dated now. It was published in 1974. When did we land on Mars? (pause) The information in this book is inaccurate because these were guesses. It . . . [was shown to be wrong] . . . Don't just believe something because it's in a book. [Just because] information is in books means nothing. Believe your experience!*

The other example occurred in another junior high school. The lesson was drawn from a locally developed social studies curriculum on local history. This particular lesson was about plans to go out and observe. Mr. Zerlof first asked:

*What have you observed about conditions in the neighborhood? If you want changes, who do you go to see [to complain about them]? How do you describe what you have observed so they will know what you are talking about? . . . so they'll believe you? So they won't be able to deny it, just by saying it isn't true!*

After students described some things that are bad about the neighborhood, Mr. Zerloff asked:

*What are you going to do about it? [If you're] going downtown to tell someone about the neighborhood . . . [you have to] go to the right people . . . [you] have to be very observant and very fair. If you do these things intelligently, you can get things done.*

*What is observation? Now close your eyes! Close eyes! Mattie, your eyes aren't closed. You're peeking. O.K. Everyone's eyes closed? (He moves to the back of the room, in behind all the seats.) Now tell me, what am I wearing today?*

And so it went, 'til one boy gave a complete account of all his clothes, down to the shade of the suit and even the heels on the teacher's shoes.

After further discussion of neighborhood conditions, they turned to questions of ways to represent their observations. How could they formulate what they observed? One way was mapping.

*Right! O.K. Draw a map of this school, the exterior and surroundings.*

There was some explanation, but the main idea was "doing it your way." So they set about constructing maps of this familiar territory. Almost immediately, questions of perspective and scale came up: what to include and exclude offered excellent mental ground for questions of formulating knowledge, the relationship to purpose and problem, and the necessity to reduce and simplify, etc. The teacher discussed perspective, urged them to finish, following their own immediate preferences.

Other examples of discovery inquiry teaching were observed in a high school biology class and in a special afternoon discovery-oriented science workshop, both of which will be described later. More commonly, the conduct of classroom activity reflected the dominant pattern of concept learning through reading. Reading was Ms. Odom's predominant emphasis in her teaching, although she also conducted demonstration experiments for her classes. The classroom's furnishings and equipment fit demonstration teaching. There was only one science table and sink, located at the front of the room. The students sat at individual desks and chairs. Thus, a widespread and common mode of classroom science teaching can be illustrated from the field notes on her class.

Ecology and life sciences seemed to be the favorite topical emphases in both elementary school and in junior high general science classes. There is evidence that the teachers capitalize on interest stimulated by and contexts provided by the mass media.

*February 16, 09:30. (Arrived late; taxi problem.) Books are out (Chapter One of Life Science by Wm. Smallwood, Webster Div.: McGraw-Hill, n.d.). Twenty-one kids in the class. Ms. Odom doesn't sit down. She moves about the classroom, or stands, or leans against the window sill. Students begin reading out loud from the book. There is a kind of dialogue. (I do a sketch map of the room.) On the blackboard is the following:*

Feb. 16 7-204

*Life Science, Chp. 1*

*Objectives: to learn what the life scientist does when he works.*

*1. What is life science*

*New words*

- |                      |                       |
|----------------------|-----------------------|
| <i>1. biology</i>    | <i>4. experiment</i>  |
| <i>2. predaceous</i> | <i>5. observation</i> |
| <i>3. data</i>       |                       |

Ms. Odom: Don't laugh when a person pronounces a word wrong. (The word is predaceous). Let's discuss "predaceous." Has anyone heard the word "predator?" (A child in the third seat, second row, answers "I have," but his voice is low. I can't hear him. They go on.)

T: What is life science?

S1: About animals.

T: O.K.

S2: About insects.

S3: Branches.

T: What?

S3: It's about branches on trees.

T: About all living things.

S2: About people.

S3: . . . Plants.

S4: About environment.

T: OK, you read. (she points to the child in the seventh seat, first row. He doesn't want to read. Ms. Odom calls on another student. That student, fourth in second row, reads.)

T: (in an encouraging tone) Talk louder, little girl. (Student reads louder)

T: Remember our objective this morning is to learn what a life scientist does. (They stopped reading just before they got to the section on data and experiments. Later Ms. Odom explained to me that since time was nearly up, she chose to stop there and would go on the next day with the section on data and experiment.)

T: There are three words we will never forget . . . (pause) life; plants; animals. (She told one of the students to take up the books.)

Her next class illustrated the next phase of this cycle of the assign-recite-test-discuss pattern of teaching-learning events. In the test stage of the cycle, students start the period by taking a test on material they have been assigned to read and which they have read aloud in class.

As the students enter and gradually settle down, Ms. Odom directs their attention to the blackboard, where they see the following written:

Feb. 16 8-216

Chap. 3: Ecosystems

Review Test 10 minutes

1. What is a population?
2. What is a habitat?
3. What is a niche?
4. What is a pest?

Ms. Odom writes "10 minutes" on the board.

T: Don't write the question; just write the answer in complete sentences. You hand things in and I don't know what you are talking about. (Ms. Odom begins to take attendance. She finishes the roll and writes on the middle black board.)

Chapter 3, page 39  
Ecosystem

On the board next to it she writes:

Homework: Watch, 7:30 tonight  
"Wild Kingdom," channel 4

1. Name the population.
2. Name the habitat.
3. Describe the niche.

S: What time is it?

T: It's time to finish. Put your names on your paper and pass them to the front. (Books are passed out. As they are ready to begin, Ms. Odom asks:)

T: How do we learn?

Student chorus: We learn by reading.

T: We'll let a reading team read to get through the reading quicker. (A set of about five students begins the reading. They read about community.)

T: What is a community?

S: A group of a population living in a particular area. (He reads this nearly verbatim from the book.)

T: What is a population?

S: A group of plants and animals.

S: (Seventh in second row) Population is a group of one kind living in a given area.

T: (turns to another student)

S: A group living in an area of one kind.

T: A group of one kind.

S: (Seventh in second row) That's what I said!

(I shake my head "yes." I got excited by the slight, too. Oops, teacher sees me!)

T: Is that what you said? I just wanted to make sure everybody understood. (Ms. Odom writes "community" on the board. The students start giving examples of habitat; she writes down everything they offer: pond, forest, soil, tree, mud puddle, river, mountain, cave, desert, ocean, lake, jungle, lily pad, stream, rotten log, Coney Island [gets a laugh]).

These class scenes were my first classroom observations. They proved to be fairly representative of classroom activity in most of the classes I saw. Naming and defining were the main focus of the approach. In most classes I observed this seemed to be a central concern, with a few observed exceptions, even when the activity was a project, or "experiment." Ms. Odom handled it well. In Ms. Odom's classes the students were interested in and found rewards in this style of conducting science lessons. Nevertheless,

as will be clear later from their interviews, the students prefer a less book-oriented classroom style. Reading aloud represented a tried-and-true procedure for dealing with many students' poor reading ability and assured "academic engaged time" (see Rosenshine and Berliner, 1977). Certainly it would be inaccurate to say that Ms. Odom did not teach that science is inquiry. But it would not be accurate to say that she taught science-is-inquiry by using a discovery approach. She was superb with the social organization of seventh- and eighth-grade classes to be taught with a heavy textbook emphasis. Yet, all her ability at organizing classes to get down to work did not shield her from disruptive behavior. She reported students had walked across the desks and yelled insults and curses at her. Only in retrospect did I begin to fully appreciate how her skill at social control enabled the serious students in her classes to get on with their work.

The two high school biology classes I saw revealed "hands on" activity as a regular part of at least one teacher's approach. Cultures in Petri dishes, comparison observations over time, and "control" compared with "experimental" specimens were main emphases of this teacher's classes. By the time I came to this class, I was acutely aware of shortages of materials for conducting everyday "hands on" work. Thus, as Mrs. Xeum gave out fresh mushrooms for the next biology lesson, I wondered whether she had "bought" the mushrooms herself or whether there was a reliable quick source for such perishable materials. Subsequently, I learned from the high school principal that a per pupil allocation was made each year for "perishable" supplies like those mentioned for biology. The head of the science division, Mrs. Yeager, suggested that small supplies of that order weren't a problem. In the high school the real problem, she said, was the large-scale costs of renovating the science rooms so classroom activities could be organized to better simulate science laboratory research.

Ten or so high school students were being trained in an afterschool workshop to work with young children in an inquiry/discovery science museum. This was to be a summer job for them. They were learning how to do their work in part by doing the "experiments" that they would later do with young children. My observation of the group suggested they were not yet practiced in the intellectual process of formulating, testing and eliminating explanations in association with manipulation activities. Some students were very good at carrying out the manipulations, but the intellectual part of offering an explanation for the phenomena, and then retesting to try it, or to modify it, was not something they did readily or easily. They were motivated; but the refined art of inquiry was not yet present in their actions.

#### STUDENTS MAKE A DIFFERENCE

Mr. Zerlof, the junior high school social studies teacher described earlier, was an excellent teacher. He had attended social studies training institutes but never an NSF Institute. He was working on a "local" district-financed curriculum project that included selected junior high social studies teachers (including himself) and a few local university social studies specialists. The project group had developed a "local city history" curriculum that began with the present and then moved back in history. Thus, the teacher's ability and experience, as well as good curriculum ideas and plans, contributed to the exceptional scientific quality I observed in the classroom lesson described earlier.

The assessment of the sources of excellence must not neglect the quality of the behavior and skills of the students in the class group. The kind of students that made up the class significantly affected what did and could happen. It could influence whether a teacher would try out new course materials with them. The contribution of the students to the excellent quality I saw in the social studies lesson based on this local history curriculum, I would venture to claim, was a behavioral contribution. As a group, it was



a peach of a class. Among their members were highly motivated, extremely bright young people. After the social studies session, I saw this "peach of a class" in general science working on science fair projects, and another time, in math class. But my most striking encounter with them after the social studies observation was in their science classroom, when I suddenly realized that several of the students were speaking Spanish to one another. I began to talk to the four or five boys, two in particular, in Spanish, to find they had been studying it for only six months. Not only had never a one been in a Spanish-speaking country, apparently not even in a Spanish neighborhood, but they were being taught Spanish by a math teacher! In a school in a very poor urban neighborhood, this intellectual "oasis" had taken shape. How teachers responded and worked with them gave one some idea of the enthusiasm and effort teachers were capable of, when not beset with student conduct and heterogeneity problems.

A natural, quasi-controlled observation opportunistically allowed a demonstration of how students influence the performance of teachers. The same social studies teacher taught both the "top rated" ninth-grade class, and the ninth-grade class that "seemed never to bring anything off right." This class was a mixture; eight to ten streetwise kids; a few already accomplished entrepreneurs of the ghetto; a few serious students; and the majority, youngsters whose most common response to school "opportunity" was lethargy. Even lively, hard-working, articulate Ms. Matlan, with valiant effort, could not seem to change their momentum. Pep talks "All right. Class 9-28 is good, but you can be, too!"

She reminded them of the reality of life outside school . . .

*If you're applying for a job and white applicants also show up, you don't get the job if you are only as good as the white applicant. To get it, you have to be better.*

And she resorted to (would you call it?) bribes. . .

*I've gone out and bought graduation gifts for them. They know about them. I told them I wasn't giving anybody a gift who doesn't actually graduate. And a lot of them aren't going to, unless they get with it and settle down to work. But they are preoccupied with the prom; and since they've always been passed in the past, they all are sure they are going to pass this time. I don't know what's going to happen to them, though.*

"This was the class" that I wanted to see under Mr. Zerlof's tutelage, so as to compare that event with the same teacher teaching the class for which everything seemed to go right. Mr. Zerlof had been absent the day preceding the afternoon I came to observe. The "mixture" class had worked with a film strip but had not been reminded to bring their work to class, so Mr. Zerlof had to improvise. He did so by passing out an Afro-American newspaper and assigning the reading of the frontpage lead article on the ethno-historical question of pre-Columbian black presence in the new world. Despite the esoteric subject, he showed his mastery of the art of teaching, winning a lively response to reading aloud, locating key words they couldn't pronounce and didn't know the meaning of, pronouncing and defining them.

*Hold it, Hold it, don't interrupt Morris! You are trying to steal this man's A. Don't do that! He needs it! . . . (Knowing laughter from the rest of the students. They were with him now. There was "property" to be won in pronouncing and defining!)*

Why this kind of lesson? Why not the city history curriculum? These kids could really live up things when it came to observations on this very neighborhood. Indeed, some of these kids are probably part of the problem that other kids in the other class were spelling out. True, the content of their "now forgotten" regular lesson on Afro-American history might well have been more relevant and exciting than this esoteric newspaper "special feature." But the circumstance, that one couldn't count on what would happen with this group "who never bring anything off quite right," is probably the reason.

for not trying out a new trial curriculum with them. Probably they would forget their work, throwing the trial use off-course, spoiling the whole effort. And finally, as Mr. Zerlot himself observed, they couldn't read with enough skill to try out the material for a more general population of students.

One could not count on "proper" conditions for doing what one intended. Preparation for a class often had little relation to what a teacher actually did. Disruption, repeated disruption, interfered. Consequently, an enormous amount of effort by teachers, principals, and aides was invested in policing "non-selected" sections of students, in reacting to misconduct and verbal transgression (including verbal abuse), and at least containing them, if not controlling or eliminating the behavior.

#### SELECTION

Deliberate selection of children to form homogeneous classes has been declared illegal by the courts. Nevertheless, "selection" occurred "naturally" with the level of difficulty of the subject matter, such as in junior high algebra versus general math, or biology versus general science; or in high school Biology I versus Biology II, or applied math versus Algebra II.

Selection helped make learning conditions better for the more capable students, poorer for the less capable. The latter often resorted, then, to disruptive behavior; but banishing misbehaving students could be more disruptive than keeping them. The banished returned, very often filled with resentment and intent on revenge, though confident, too, they would be once more punished. Teachers are a key ingredient to a successful classroom, but they seem to have no greater impact than has the interest-in-learning of the classmates.

Just as much as are materials, social relations and personal conduct are critical parts of any curricular activity. "Mainstreaming," so called, mixes not only children of various abilities and competencies, but also children habitually using diverse modes and forms of social conduct. Disruptive modes of conduct directly affect the ways teachers carry out science activities. Symptoms of stress and low morale were observed in many Archipolis teachers. My observations led me to conclude that those "privileged" to teach class sections selected by the curriculum's "naturalistic processes" (such as only students passing Algebra I), did not show the same air of fatigue and harrassment, although there was still an air of worry and disquiet about their manner. In a meeting prior to the initiation of the research, the high school principal pointedly suggested that I be sure to take note of whether each classroom I saw was one of an advanced selected group or was one of the general classes that everyone must take. In the high school, "selection" did make a difference about how much teachers contended with behavioral disruption. Though less often discussed as a salient problem by the "advanced" teachers, lack of student commitment to school was frequently emphasized as a major problem in the beginning high school classes. The fewer "unselected" classes and the more "advanced" science classes a teacher had (when asked about problems), the more he/she stressed lack of resources and the poor level of motivation of students. In this context, motivation meant unwillingness to do or learn anything. . . unless they got a grade for it. . . ." Students seemed unwilling to work to learn something--according to one high school mathematics teacher and several junior high school mathematics teachers--merely because it contributed to the excitement and ease of learning.

One math teacher complained of difficulty in getting them to think, to use their judgment, to use "sensible" estimation to test if they were going in the right direction. "They operate by rote; preferring routine, set procedures that they automatically follow rather than sense and logic." She wasn't "put out by new math." She felt it is important to introduce theory along with operational ability. This included introducing probability in the applied math class with "craps," the object being understanding and not morality. Actually, in her view, there was a "trend going on. Overall, students are not performing as well as they have in the past." Some students were lazy. Some of them should have been in an algebra class instead of a general math class, but they just didn't care about putting out the extra effort. Other teachers also complained that capable students often did not take advanced classes because they were reluctant to put out the effort. The disquiet and worry noted among high school teachers, speaking thematically, reflected dissatisfaction with lost potential and talent.

There was also heavy emphasis on the mysterious lack of skills and flexibility in applying what students knew in one context to a new or different context (the process of "transfer" as opposed to the process of "mastery"). One way to think about it is the way the high school principal talked, when he referred to the extreme compartmentalization in the subject domains on which the children work: "The knowledge gained in one class is not used to supplement, complement, or add context to the subject matter from another classroom setting." The extreme of this process is the tendency to compartmentalize each lesson forgetting one when going on to the next, so that every "topic" is unrelated to the next. Even inside a single classroom, compartmentalization from lesson to lesson seemed to occur. Miss Matlan told her general math class: "When I give you something new, you forget what you've done before. And all those things are interrelated. . . ."

#### BEHAVIORAL DISRUPTION

Testimony before Senator Birch Bayh's committee hearings recently indicated that the concern about undisciplined behavior in schools is a widespread concern in our society. The junior high teachers in the Archipolis system were weary of "policing" (their word) the behavior of many of the students in the five or six sections of science each teaches. They perceived that only some of the students caused disruptions that affected all the students. In their view, the problem was that they couldn't remove the children who did cause trouble, so that those who wanted to work could work. Thus, much class time was spent in making the students conform to a behavior that allowed students who wanted to, to learn. There were classes that were exceptions. Teachers looked forward to teaching these groups. As far as I could judge, these were the students on whom they expended their best effort, and on whom they tried their "newest" materials and most challenging ideas.

The preoccupation with student conduct and social control took a heavier toll of time and energy in some schools than in others. In the classroom, "policing" refers to controlling loud raucous behavior, noisy verbal combative prattle, disruptive talking, loud comments, talking back to the teacher, insulting other kids or the teachers, and physically moving around or in and out of the room without permission, and sometimes contrary to directions from the teacher. These effects are more likely to be present in junior high school than in senior high school. They are less likely to be present in selected classes involving advanced accomplishment. Policing was most likely to dominate teacher effort where a section or class was taking remedial work.

Hall behavior in junior and senior high school, where students moved from class to class, was the focus of assistant principals, hall-duty teachers and principals' aides. Fast physical movement, labeled "ripping down the hall" in at least one junior high setting, led to the half-humorous advice "good luck and stay close to the wall." This physical movement happens in a sea of loud voices, laughter, slamming locker doors, and bursts of other sounds. Even while classes are going on, some schools have a particularly difficult problem with students who wander around the halls. Some are just tardy. Some are cutting class by hanging out in the halls. Some are chronic class cutters who wander about finding other classrooms to enter and disrupt. This seems to happen despite the control mechanism, particularly in junior high school, of requiring a permission slip for departing the room. Spending a day with a teacher gives one a clear sense of how difficult it can be to control the movements of older children with such traditional mechanisms.

When I spent the day with Mrs. Vought, I noticed she kept the doors to her classroom locked, even during some of the class sessions. At first I thought it was "fear." (This explanation reflected my typical outsider's over-reaction to hall behavior and to the frequent discussion of incidents involving either verbal or physical aggression.) But the lock was an effort to control another condition or force that interrupted class activity as it was planned by the teacher. If children wandered in the hall, cutting classes, the teachers, principals, and "hall guards" (my words) seemed only to be able to urge them to go to class. (e.g., Teacher to young boy as we walked toward her room after the period began: "Son, go on to class now. Why [rhetorical] aren't you in class? It's past the beginning of the class period.") Expulsion required a long history of transgression and abuse of the rules of the school. Official punitive action was not impulsive. There were always at least a few students wandering through the halls during classes, sometimes (often) stepping inside the doors of classrooms cheerfully to catch the attention of some student within.

During Mrs. Vought's class, for which she had prepared a discussion and project demonstration leading up to a whole-class project, I noticed the rising sound of conversation coming from the back of the room near the double doors. A young boy stood inside the door, at first talking, then arguing with a girl and several boys. Apparently an exchange with the girl had spilled over into verbal sparring with the other boys. The word-skirmish rose to a crescendo of sound until the whole class was caught up in it, totally distracted from their books, papers and from the discussion of the science lesson with the teacher. Finally, the teacher seemed to give up the idea that the episode would just go away. (Patience is an adaptive procedure one seems to learn to use in this environment, unless one's job is trouble shooting. Otherwise one would deal with nothing but trouble. In Van Dryck Jr. High School, you don't have to go hunting for trouble.) She called across the room to the boy to "go on out, now. This is class, and you're not supposed to be here." The noise of conversation subsided but he didn't go out, and he now had center stage. The "expulsion" process went on as the teacher moved by stages from the front to the back of the room. There was no militant charge. (How could she stand all this prolonged agony!) Finally she reached him, having all the while given voice to why his behavior was not only inappropriate but was leading to his own loss eventually, remarking that it shows how little he has learned from anywhere--either school or at home--about how to behave. Gently she pushed him out between the double doors, talking all the while . . . and locked the door behind him. So that's what the locked door means, To keep out hall wanderers--to cut down on disruptions.

By this time the forty-minute period was nearly gone. At the front of the class she said, "Let's get back to the question . . ." And for a half-hearted five minutes, she carried on amidst a continuing buzz of student conversation. "All right, Jimmy Joe, collect the books" (they were working in Pathways to Science). After class, she turned to me, apologized, shook her head sadly and said,

*I'm glad you saw it. Now you know what I mean when I say it doesn't seem to matter how much time you put into planning a lesson, how many hours you put into collecting enough staff together so the whole group can carry out*

the project. . . You just never know what's going to happen. It is just wasted. So often it is just wasted. I get so tired. . . so tired of it.

On another day I saw what the teachers meant when they often talked of lack of respect. I was in the class because I had returned to interview students; but another period began before I left, so Mrs. Vought invited me to stay. At long last I was to see a "project" activity. Two weeks before, this class had gotten excited about a unit on sound, particularly the result of holding a tuning fork against different sized containers of water. The floor had been a sea of wetness, but Mrs. Vought cleaned it up gladly. Moreover her account echoed with delight that they had experienced the kind of excitement toward science she herself had experience in an NSF Institute. She wanted them to experience that excitement, too.

The project guide for this eighth-grade session was in Pathways in Science. As she checked the roll, the books were handed out; just as the class was about to settle down, about two minutes after the bell, three boys sauntered through the door. She looked up and said,

"Where's your tardy slip?" Sullen silence. "You'll have to get a tardy slip," to which one of them said he needed a note. With this, they started to move to chair and desk--now less with an air of bravado and more with unobtrusive body English, to slip in unnoticed. "Wait!" said the teacher. "Come back up here. Stand up here by the door until I can get this note written." They moved, two with bravado, the third now trying to locate himself half way between the door and class, so if given a chance, he could slip into the anonymity of the class. Then began many minutes of mischievous and verbal exchanges, and with each exchange an escalation of feeling and more writing on the note 'til suddenly the lights flickered off, on:

"Who did that?"

"I didn't. . ."

"You did, Lynn."

"Hurry up with your note; I want to go. . ."

"Do you want to leave this class or stay?"

"Yes. . ."

(More writing, more light flickering.) "You'll not come back to this class without your parents' visiting."

"Give it to me; I don't want to be in this fucking class!" (Simple, brief silence as she finished.) "Hurry"

"Wait!"

She went to the door, gave it to him. He was agitated now, and to her admonition to take it directly to the office he yelled back down the hall, "You get out of my face, you mother fucker, you!" A gasp and titter and loud laughter from the rest of the class. The other two boys were told to go to their desks as the class turned to. . . what? The shambles of "the planned lesson."

Several days later, Mrs. Vought came into the teachers' lounge where I was chatting with two other teachers. She said "Oh, Dr. Hill, I wanted to tell you what happened with Lynn, the boy who behaved so badly the last time you were here." She recounted his return. He came back to apologize. He was really sorry. She said,

He's not a bad boy, and his family does care. I think the three of them just got into something. . . Anyway, I told him I was sorry it had happened, too, and I was glad about the apology; but I could only accept it if he offered in front of the whole class, because in a way he had insulted them, too. So he did do that and I gladly accepted the apology. It is so hard, though! They aren't bad children.

In the junior high schools the salient issue was "mainstreaming": not so much random mixing of abilities, but the mainstreaming of youngsters with behavioral problems, "juvenile delinquents" as they were sometimes referred to. This was no small concern. Children were being returned to the schools, and to the same classrooms, by the court. A federal court decree assured these children the right to re-enter those classrooms. Following this legal mandate of the courts, the teachers of one of the junior high schools submitted a petition to the teachers' union to initiate a "class action suit" on their behalf.

The stress ran deep. One day I entered the teachers' lounge with Ms. Odom during her free period. I saw an older man with close-cropped hair sitting at the end of the table nervously smoking a cigarette. He held his head with one hand, stroking back across his hair from time to time as if to relieve it of pain. When introduced to me as Mr. Thomas, math teacher, he asked if I were there to introduce a new curriculum. I said "no, not this time." I was there to find out what was happening now in science teaching and what teachers thought of it, good and bad. He said:

*You get kids and they don't know what they should know to do the work. Since they can't do the work, they act up. They don't want kids to call 'em dumb, so they act up to cover up the fact they can't do the work. . . They can't subtract and multiply. They know theory and sets but can't subtract. . . New math seems to have done that; the paper says high school grads can't even read!*

Q.: Do you want to go all the way back?

Mr. T.: No, not all the way, but some. . . Oh, I got a headache just looking at this school this morning. . . A kid said to me. . . pardon me. . . he said to me, "Kiss my ass." Teachers have no rights anymore, only kids. (He rubbed his aching head and drew deep drags from his cigarette.) Kids are all mixed up now.

Q.: Is it the size of the classes?

Mr. T.: No, size isn't it. You can have fifty who want to learn and still have a good class. We're not allowed to group kids homogeneously. You'll have kids in a grade who can do the work, but some who are two or three grades behind in reading; you have to individualize or group. You can't teach otherwise. But you've got just a security guard. (Then). . . Come to my second period class. I'll show you what good kids can do.

#### PARENTS

Parents I found have strong sympathy and support for teachers in this matter. At the end of an interview with one parent, I quoted from the petition being composed by the junior high school teachers in the school her children attended.

*The teachers of Roosevelt Junior High School request a class action suit to protect the rights of our serious students. The quality of education has been severely eroded by the behavior of a few students who make life miserable for the others. The noise, the commotion in the halls created by class cutters, distracts students from their work. Teachers are being verbally*

*abused and physically assaulted by unruly students who cannot be expelled from school because of legal restrictions. Juvenile delinquents are placed in the schools by the courts regardless of their effect on other children.*

She listened, then shook her head and said, "It's true, that's how it is. . . I see it when I'm there. . ." The conversation went on, then ended with my thanks. At the next interview a few doors away, I found a similar sympathy and a further agreement that many parents don't assume responsibility for their children: "Half send the children to the teachers to raise 'em and learn them, too. Teachers have a job on their hands." Those two interviews were not arranged by the schools. The force of sympathy with the teachers' plight was remarkable to me.

Parents also had definite ideas about the curriculum. In junior high the children are asked what subjects they want to take, but one parent said it is

*. . . learning to read and good spelling that matters most. They need that bad. . . and typing, they need that, too. Now the school offers most everything--if the children would take advantage. . . Children are different now. I think they have a good opportunity if they'd just take advantage of it. . . they have more than I had. . . They've got it good if they'd just take it.*

Of the three science areas I mentioned, she felt math is more important than social studies or science. She added, "Reading is important. That is my idea. But they don't seem to read well enough for the grade." She noted her agreement with the practice of the past, that a child didn't pass until he or she "[got] it for certain." But "now they hold them back, they get disgusted and pull out of school." Early in the interview I had asked her general opinion of school and how well the school was doing in the education of the children. "The teachers do most all they can do, but some of these children is another thing." Later when she spoke of how her children take advantage of the good educational opportunities offered them, she spoke of the need for parents and teachers to get together and talk and see what they can do.

The parents and teachers and students, too, are aware of the obstacles to learning and the disappointments of teaching brought about by student disruption. What is less realized is that managing a classroom to avoid or curtail disruption requires talents separate from the talents for teaching children their lessons. Since children cannot learn their lessons if the disruptions are not managed, those teachers who do not have the management talent are driven from the school. The shy math teacher finds it much more rewarding to work in the city assessor's office. The contentious science teacher is encouraged by the principal to transfer. Thus, the number of good teachers available to staff the school is farther reduced.

#### STUDENTS' VIEWS

From the point of view of many students, the best "science experience" of their school careers was the several days they spent at Field Science Camp at Mt. Airy. References to this camp program came up again and again in student interviews. The field experience seemed to have brought home to every one the part that observation, in the full sense of description and examination, plays in biological and physical science. Its effect on the students apparently was lasting! Given its indelible effect on the minds of the children, if I were making recommendations regarding science in these Archipolis schools, I would say the camp should be the first programmatic effort to be extended, the last to be cut back. Indeed, every effort should be made to expand it and experiences like it.

In addition to recalling their trips to Mt. Airy, students shared their conceptualizations of "What science is" or "What kinds of science are there." Many similarities arose across the students' interviews. The most common response in junior high students was that "Science is everywhere, and includes everything." The students may not prefer the bookish study of science, but they don't conceive of it as simple word memorization. In response to a direct question on this, one eighth grader, seemingly somewhat puzzled that I would suggest that learning a word is just memorizing a definition, carefully explained to me that learning the meanings of these words involves learning more about the world, and more understanding of it. So, in my words, she was learning concepts and "conceptions" of the world around her, not just labels and definitions. It is well to keep this perspective--shared by many of the students I interviewed--in mind, should we feel tempted to denigrate the book-oriented style of most science teaching described here, as compared with an activity-oriented or inquiry-discovery style.

In response to the question, "Do you think as much of math as science?" three ninth-grade girls responded: "Yeah, in a way I do." But each had her own way of thinking, which reflects some of the procedural difficulties that curriculum developers experience in integrating the math and science teaching units.

S2: Yeah, because you have to know math so you can do science.

S3: Yeah, you have to know science in order to know math.

S2: You have to know math.

JH: You have to know science in order to know math?

(Chorus) S1: You have to know math to know science.

S3: Uhuh, cause. . .

S1: Some of the formulas. . .

S3: I don't think so, because everything in this world deals with science; anything you see.

JH: (Speaking to S1 and S2) But you girls think it's the other way around. You need math to know science?

S1: Yeah, 'cause the formulas. . .you gotta know some math in order to solve the formulas.

JH: Of all the things you've ever done in school in science, what's your favorite thing that you remember?

S3: My favorite was when I went to Mt. Airy (the camp).

JH: How about you. . .(S2)?

S2: I don't know. I like to do experiments.

JH: Any one in particular?

S2: I remember one this year. We had to measure the sand. . .and I liked the distillation of wood, too.

JH: You did? Did you girls get to do that yourselves or did you just watch the teacher do it?

Chorus: We did it ourselves.  
There was two in a group and  
they worked together. . .lab partners.



JH: Now through junior high, have you done more things like that with Mrs. Vought than you have with other science teachers?

S1: This is my first time.

S3: My other teachers, they would do. . . my seventh-grade teacher really didn't do that much because he hardly came to school. My eighth grade teacher, he would do experiments but we would just watch. This year, we get to do experiments ourselves.

JH: So do you like that better than just watching or would you rather have the teacher do it?

S1

S2

S3: Unhuh (other comments that it's better to do them yourself).

S2: In the seventh grade we didn't do anything.

S3: Yeah, we had the same teacher.

S1: We just had work in books.

JH: Do you find most of your science in school has been that way. . . you read, answer the questions? How does it go?

S2: You take and read the chapter that's been assigned to you and then you answer the question in the back after you finish reading.

JH: And then what happens?

S3: You check the work.

JH: The teacher checks it?. Do you then discuss it in class?

S1: If you don't understand it.

The students also think of social studies as science. But since "observation" seems to be an important feature of science-like things, more detailed exploration of their models of science seems to be warranted in future research.

The "reading question" also had its student-oriented side. The students' views are not monolithic, but cover a range of perspectives. The modal position seems to be a preference for "projects" over "bookish" exercises. Their tastes run to a decided preference for "the multimedia" approach, as the following group conversation with an eighth-grade section reveals:

JH: Suppose you had the possibility of getting whatever kind of science that you wanted in school, what would you want?

S4: Biology.

S2: Bunsen Burner Science.

JH: Like, if you could have that in junior high, what else would you ask for?

S4: I would say some kind of science that would help me with the job I want to get.

S2: Yeah, me too, me too. Like experiments.

S3: I don't like to experiment.

S4: Yeah, I like experimenting.

JH: Would you like to work in a kind of laboratory?

Chorus: Yeah! Yeah!

S3: And have my own laboratory.

JH: And have your own laboratory? Well, that'd be really jazzy.

S1: I want to learn how to do blood tests and those things.

JH: What about going out on field trips?

Chorus: Yeah! Yeah! No school.. Yeah!

S3: It'd be fun if you don't have to write nothing.

S2: Yeah.

JH: You don't want to write it up?

S2: Just observe, just tell 'em things.

JH: How would anybody know what you saw?

S4: I know, but. . .

S3: Take pictures.

JH: But you'd have to. . . take pictures.

S2: Yeah; use a tape recorder or something.

JH: Take a tape recorder or something?

S4: Talk, talk.

JH: Oh! So that's what you'd rather do. Collect your information and record it.

S3: I'd rather do something than just write it down as you go along to get it out of the way. . . "He done this and this and this."

JH: Well would you like to have tape recorders instead of books?

Chorus: Yeah!!!

S1: You can really hear it.

S2: Yeah, put it on your ear.

S1: Then you can understand it better than reading because they describe it in more detail than the book does.

S2: Someone won't interfere, right?

JH: What if you had those individual slide things so you can see pictures, too?

Chorus: That's right!

S4: I think you could understand it then when teachers say, "Read this! And read that! And write this down!"

S2: It's like somebody said, it's better for you to do something than it is to get it out of the book; the book doesn't give you all the knowledge.

JH: Umhum. If you could do those things, do you think you'd behave yourselves?

S2: Yeah.

JH: Honest, honest, honest. You think you'd be quieter?

Chorus: Yeah!

S1: You have to be quiet if you want to hear what's goin on.

Some student views range toward the elitist view that the problems with poor reading are due to "lower mental capacity of individuals." This view came from an exceptionally talented young ninth grader whose own experience was that "reading came naturally to him." His theory was that it should "come naturally" to most children of average or better capacity during the first and second grade. If it didn't, they were "in trouble." Actually, in the minds of some students, reading was inextricably interwoven with writing and written composition. This may represent a modal perspective of the students, since the "read-find answer-write answer-turn in written work" pattern of activity was so ubiquitous among all the classroom situations I observed. Take note, however, of the pedagogical theory implicit in the proposal of one of the boys in the preceding quotes. If he can compose his account of his observations on a tape recorder and then transcribe his account from the tape, he would be satisfied. The struggle with orthographic and formatting skills seems to get in the way of his concentration on meaning. His solution is to separate the two problems. This technique, with refinements, is being used in many settings. There is wisdom in the minds of the children. Yet, given the previous account of the limited material resources of this school system, the marginal economic condition of the main portion of the population, and the constant daily presence of theft of property (an exchange the jaundiced eye of the anthropologist might see as an economic redistribution device in a politically disenfranchised, subordinated, economically marginal population), one cannot realistically imagine that this "equipment-dependent" solution is workable.

The students are grade-conscious. Thus, one says she likes school ". . . as long as I get A's and B's." Getting lower grades, "C's," means she has to work harder. She and children in other interviews indicated that a drop in grades results in punishing reactions from parents: loss of T.V. privileges, scheduled homework sessions, and moratoria on telephone calls. There were allusions to physical punishment, but no actual incidents were described. The teachers' consternation over "grade-oriented" materialism appears to overlook the connection between children's grade consciousness, and the degree to which grades carry the main burden of communication between schools and parents about their children's work performance. Most children regard school as work, except for a small minority who, like one ninth grader, had developed an urge just to "have knowledge," to be knowing and knowledgeable. Certainly work effort is measured in grades by the students; i.e., if their grades "drop," they must work harder to get them up to the A and B level. Moreover, in this system so heavily affected by legal restrictions on the exercise of other forms of social control (physical punishment, expulsion, etc.), grades are a main means of reward and punishment.

## NSF INSTITUTES

The experience with an NSF-related Institute was less often encountered among social studies teachers than among math or physical-biological science teachers. It was much less often found among elementary school teachers than among junior or senior high teachers in the math or science areas. A young mathematics teacher was sorry NSF Institutes and other support had seemed to disappear (a common observation among those teachers who had experienced them). He valued the institutes not for their pedagogy, but for the conceptual understanding of the subject and the discipline they had offered. This teacher said the math he teaches now is more mathematically sophisticated than he would be able to teach had he done his degree work in education. A NSF-supported program allowed him to get a Master's in mathematics in a math department rather than in a department of education. He and other high school math teachers would have liked more institute experience in order to keep up to date on developments in mathematics.

There seems no doubt that for all science areas, for those teachers who had attended NSF Institutes, or off-shoots of them, the experience was an intellectual shot in the arm (or to the head) that they now sincerely miss. A junior high math teacher emphasized what she called "leadership." She claimed those who had attended NSF Institutes were heavily represented among those leading efforts to improve professional work conditions in the school, whether curriculum changes, teaching conditions, inservice training, organized teachers' efforts or whatever. Sorting out correlation and causation is a problem with such a claim. One social studies teacher who had never been "selected" to be invited to an institute suggested that teachers favored by "the administration" or some other decision maker were the ones who were chosen, not less favored teachers like herself. Thus, selection of participants who are "leaders" in the first place may be the explanation for the "leadership" phenomena. The institute experience, of course, might reinforce an already existing propensity.

## RESOURCES

In the high school, the most salient innovative aspect of the math program was the presence of computer terminals for time-sharing with local city government's computer facilities. (The city furnished the schools with computer time.) The resources for transforming the computer terminals into a widely used, reliable, regular teaching-learning experience weren't yet available. The room itself was small, so that doing classroom work and terminal work in the same setting was a "noisy" affair. There was no money to pay for assistants who would oversee the machines and individually help the students when Ms. Gregory was out of the room teaching other classes. Thus, she had to use students volunteers whom she herself had to train. But scheduling their available time on a dependable basis and getting them to the level of understanding at which they could independently help other students with their problems was not something Ms. Gregory had been able to bring off. Without this, Ms. Gregory said she simply couldn't leave the facility unsupervised for other classes to use at their pleasure. The hard reality was that if students did something inadvertently to one of the terminals, it would soon exhaust the budget available for repairs and parts. In addition, another major expense loomed, underlining the hazards of dependency upon another institution's resources. The city government was planning to change the program package used on the computer, thus involving enormous investment in man-hours to revise the schools teaching materials, etc.

The effects of marginal materials resources on projected plans and teaching activities was depressing. Although resources for high school biology were described as generally adequate, I heard from many teachers examples of six- to eight-month delays between the time materials were ordered and their arrival. A high school teacher spoke of putting in an order, and having all of it back-ordered repeatedly, a more distressing experience perhaps than knowing what you order this year won't come through until next year. There was an ever-so-tentative, but ever-so-frequent, suggestion that the way orders were handled at the board of education central supply office resulted in mixups, delays, and unfilled orders. Most teachers' emphasis was not so much on insufficient funding resources per se, but was on getting an order filled, any order. Teachers were often thrown back on their own resources; many furnished materials out of their own pocket. The science teachers had a continuing collection: bottles, scraps, and whatever might be used by students or teacher in classroom experiments or demonstration. One junior high teacher patiently and thoroughly washed out the gallon containers that ditto fluid came in, to use in the class demonstration of the classic "air exerts pressure" experiment.

The most reliable means of instruction was dependence on the spoken word of a teacher equipped with a ditto machine. Even a shortage of text books could be better controlled if one had a ditto machine, ditto fluid, and access to a thermofax machine. Cheap and simple to operate (most had hand operation features if the electrical system went out), they were quick, dependable resources. The marginal nature of the materials resources contributed to the ubiquity of copying chapters or sections from several texts and making them available to students for text-oriented school work. Even so, well-laid plans could be fouled by theft, if not by shortage or delay. Plans to give biology to some of the ninth-grade sections in one junior high, for example, were abandoned when all the supplies and equipment for the course, carefully collected in the late spring and locked in the storeroom, were stolen during the summer. Only a few specimens of embryos, that somehow didn't interest the thieves, were left. So the ninth-grade sections that would have had the experience, simply had an advanced section of general science.

In another instance, one section obtained Introductory Physical Science materials that the science teacher had learned about in an NSF Institute. To teach one of the classes about the balance beam, she set up a "project" involving the weighing of pennies, requiring that each penny be identified and weighed on several specifically identified balance beams. The students could not finish that day, so they left the beams and pennies set up and locked in the storage room. When they returned the next day, they found the pennies stolen and the beams out of order. The teacher recounted other such incidents and tried to explain to me the depth of her discouragement. I found myself beginning to question, "What resources of all sorts are required to carry on ordinary science education activities?" The material resources necessary to carry out science as projects, or to do classroom simulations of physical events so that scientific ideas and procedures could be presented and discussed, were scanty in this environment. The most reliable resource seemed to be textbooks and the ditto machine: a technology that seriously limited the classroom approximations of simulated scientific inquiry and knowledge development. Though books that used the written word and paper and pencil to simulate inquiry and discovery were well received by the children (the Pathways in Science series was a favorite with every child I talked to), the absence of equipment resulted in the traditional pattern of "assign, study, discuss, and test" pervading most of the classrooms I observed. Along with it was a special emphasis on word labels, definition of word labels and reading, that made the sciences as dependent on reading skill as were the humanities.

One aspect of the social ecological approach is the extent to which the human being in the situations is dependent upon the largess, or lack of it, of the social and material environment. What is it one may know or must know that reduces one's dependency on the conditions and resources controlled by others? This is particularly important when that control is capricious, from the point of view of the organizational level at which classroom teaching takes place. In situations of relative powerlessness and limited resources, what approaches will reduce dependency on others or will circumvent the arrangements that reinforce dependency? Both questions are essential to consider.

On my last school visit in an elementary school, the luxury of a half-moon open space area really impressed me, perhaps more after four weeks in more spartan and ancient surroundings. What I saw was a new, well-equipped, carpet-covered half-circle community room with a kitchen and visual media equipment "strip" separating one half of the room from the other. I didn't even get a chance to see its marvelous "media center" (that means written literature and visual aids, etc.). Fourth and fifth graders were engaged at three different positions in three distinctively different activities at one end, while in the other half a teacher lounged comfortably by a table, leaning back with an open book resting on her lap and flanked by a ring of thirty or so fifth and sixth-grade children. There was a special privileged air about this school, with its lovely blue tile brick half way up the wall of classrooms. Yet there were elements of the same stress that beset the other schools I had visited. Thus, on our way to the open-space class, the assistant principal paused to admonish a little girl (seven or eight years) who was away from her classroom. "I don't see you playing in the hall, do I? No, I couldn't be seeing you play in the hall. Go on to your classroom now." So this school also had some of the problems of other schools.

#### MINORITY PROBLEMS AND SCIENCE

Probably because my study coincided with Black History Month, social studies I observed at all levels (except for one advanced placement class in economics) concentrated thematically on the history of the black population, the geography of the U.S., and the national and continental origins of the group. But without further evidence of visits at other times, I did not confirm this hunch. The emphasis on leaders, famous black scientists, and "getting it together" appeared on bulletin boards and in the teaching discourse at some time or other in every elementary and junior high school room I entered, and in some, but not all, of the high school rooms. There is a distinct message to all students that getting it together and doing well is not just a matter of individual choice and circumstance, but inevitably has implications for the ethnic group. This sense probably could not have been emphasized to such a degree in a more ethnically heterogeneous student or teacher population, whether mixed with some other ethnic minority, or in a 50-50 mix with white European-origin ethnic student and faculty population.

It is to be seriously considered, then, that the ever-present emphasis on reading, vocabulary, and articulateness is tied in some way with this sense of group mission. A minority group such as this one may pay a political price for being 'blase' about "proper" labels and articulate delivery of established ideas on a topic. The politics of access to opportunities was of fundamental importance to the teachers of these children, and was a key ideological message they incorporated into their teaching discourse. From the students' point of view, conduct and intellectual ability are thoroughly intertwined. My own observations, partly from interviews with students, led me to the claim that rowdy, disrespectful, disruptive conduct is attributed to low "mentality." By implication, if not in explicit word, such conduct is linked to the notion that these children have to acquire the intelligence to recognize their political position in the society. They must . . . "Get it together before it's too late" (final line from a grand finale song in the high school assembly program celebrating Black History Month).

Math and science have their place in these efforts. Scientists who were black were identified as significant career models for the children at all levels. This was significant because of the question of what students would do with their future. Concern about students' future extended to coping with technology, as well. Thus, computers were now part of every student's everyday life. Yet with only eight terminals and the lack of

motivation, how could a mathematics program be developed to allow the vast majority of students some experience with computers? This problem worried Ms. Gregory but she had no hopeful proposal to meet the challenge, only a knowledge that something should be done.

This ethnic group, which predominates in the city population, still lives under a persistent barrage of social denigration from other sectors of the society. Consequently, the system suffers acutely the dilemma of elitism and equalization. Elitism, denigration, and exploitation do not cease at the membership boundary of an ethnic group, even an ethnic group that has coalesced on a ideology of its own brotherhood, beauty, and worthiness. If the group members have to exist in a world of competition for socioeconomic advantage, then egalitarian measures that "average down" the potential for the exceptionally talented may threaten as much as signal relief. They see the rules changing just as they've been admitted to the game. The personal reputation, identity and destiny of each individual in an ethnic population living under those conditions is closely tied up with the reputation, social identity, and destiny of the group vis-a-vis the society at large. Contrarily, no person identified by others as a member of this population can easily escape the extension of the group's identity and destiny to himself or herself. There is anxiety among teachers (and parents, too) that social and political battles are being lost. Some may view the teachers' growing opposition to mainstreaming and random mixing of all children, whatever their mental performance and behavioral conduct, as a self-interested, middle class, elitist rationalization on the part of a subgroup that "has it made."

But that would be a limited understanding of the special characteristics of the system. For it also should be borne in mind that the school system--not the economic system of private business and labor nor the political system--is carrying almost the entire burden of instituting equality of means to uplift a disadvantaged population. The agony that I often saw in the day-to-day life of school persuaded me that school system cannot bear this burden alone among the institutional systems of any city, or any society. That excellence in science teaching and learning happens at all is gratifying, given the exceptional political and legal conditions and the economic agonies to which this system is now exposed.

#### EPILOGUE

Beyond the school, the home, and peerdom, and out of the amorphous notion of community, the courts have emerged as a key power influencing school curricula. To protect individuals from the injustices arising from greed and prejudice and perpetuated by bureaucracies, courts are directing activities of the schools. As operations are reorganized and resources reallocated to accommodate court requirements, the curriculum is bent to fit the new circumstances. Teachers and parents in Archipolis were aligned with one another, blaming "other" parents and the peers of their children for the schools' problems. Young people blamed teachers and "other kids." And I had a sense that there was an invisible "fourth force" exerting influence on the situation, checking the exercise of traditional authority by adults over children. The teachers' petition named the courts, but the personal exercise of the courts' authority was vested in agencies. Thus, public service agencies might well be viewed as wedged between the traditional authority of teachers and parents with respect to the public actions of young people. From this came the air of puzzled ennui that marked the outlook of many teachers. Although the courts are honored in a city peopled mainly by blacks, the teachers' petition to the union to initiate court action was a sign they had come to terms with the reality that courts, in the name of principles of justice, also can instigate havoc and hardship. The teachers have sensed that the path of counteraction is legal action, and they are moving to get that counteraction into motion.

There is evidence in this account that NSF Institutes have had a positive influence on teachers and the conceptual sophistication of their teaching. The teachers have missed the Institutes and the support they lend to strengthening the quality of technical and scientific understanding in teachers. It is notable, however, that the most obvious examples of scientific sophistication in social studies were not from NSF-trained teachers, but from teachers of social studies involved in a local effort. Curiously, while teachers and students live in an ambiance of the stuff on which the social and psychological sciences work and thrive, there is less evidence of NSF influence there than in any of the other several sciences. Support for social science seems to have come from agencies of social service and of the humanities and arts. So the social science activities that occur are mainly oriented to service and artistic perspective, and, in general, show much less scientific sophistication than other school sciences.

Clearly, science in schools is significantly and critically affected by the social context in which it occurs. Much might have been learned from a greater emphasis on conceptual content and materials of the science teacher. Nevertheless, discovery of what is or isn't taking place in school science, and understanding how it is that good school science cannot happen easily in many urban school settings, cannot be readily accomplished from that point of departure. Staying exclusively with questions of curriculum content and subject matter competence is a way to avoid the messy reality that school science really is. Probably no federal agency would willingly take on such a mess, least probably an agency of science. Still the question comes. Who will? Who will?

The school itself is a politically and economically weak institution. There is evidence of that weakness in the relationship of this school system to the courts. Its vulnerability as a taxing body cannot be described here. But the schools' constituency is predominantly a political minority. And the poor economic condition of the majority of the population served by the city public schools excludes the possibility of significant support or supplementation from some private sector. This is clearly a setting for posing the great puzzle of how elite science training can be brought to fruition for and among a politically and economically subordinated population.



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